91122R03
VOL. II
2ND COPY

PROGRAM MANAGER FOR
ROCKY MOUNTAIN ARSENAL

Interim Response Action
Basin F Liquid Incineration Project

DRAFT
HUMAN HEALTH RISK ASSESSMENT

Volume II

Preplaced Remedial Action Contract
Contract No. DACW-45-90-D-0015

January 1991

U.S. Army Corps
of Engineers
Omaha District

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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THIS DOCUMENT IS A COMPREHENSIVE, MULTIPLE EXPOSURE PATHWAY, HUMAN HEALTH RISK ASSESSMENT PREPARED FOR THE BASIN F LIQUID INTERIM RESPONSE ACTION. THE OBJECTIVE OF THE RISK ASSESSMENT IS TO ESTABLISH CHEMICAL EMISSION LIMITS FOR THE INCINERATION OF BASIN F LIQUIDS WHICH ARE PROTECTIVE OF HUMAN HEALTH. ALL POSSIBLE DIRECT AND INDIRECT EXPOSURE PATHWAYS AND SENSITIVE SUBPOPULATIONS WERE EXAMINED. IT WAS CONCLUDED THAT THE INCINERATION FACILITY POSES NEITHER CARCINOGENIC NOR NONCARCINOGENIC RISK TO ANY SENSITIVE POPULATION.

THE ASSESSMENT IS DIVIDED INTO THE FOLLOWING SECTIONS:

1. INCINERATION FACILITY DESCRIPTION
2. DESCRIPTION OF SURROUNDING AREA
3. PROCESS OF POLLUTANT IDENTIFICATION AND SELECTION
4. DETERMINATION OF EMISSION RATES FROM INCINERATION FACILITY
5. AIR QUALITY AND DEPOSITION MODELING ANALYSIS
6. DETERMINATION OF KEY PATHWAYS AND POLLUTANTS

14. SUBJECT TERMS
AIR QUALITY, EMISSION RATES, TOXICITY ASSESSMENT, IRA F, SQI

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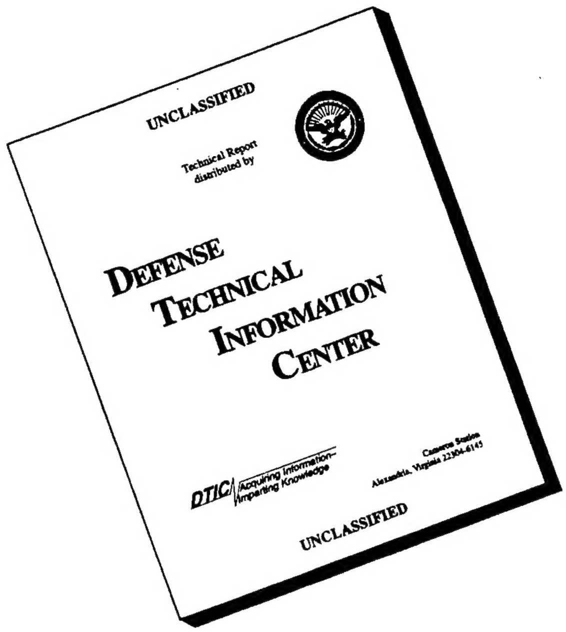

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LIST OF APPENDICES

APPENDIX 3A

DATA ON DESIGNATED FISHING AREAS

STATE OF COLORADO
Roy Romer, Governor
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WILDLIFE

AN EQUAL OPPORTUNITY EMPLOYER

Perry D. Olson, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192

REFER TO:

October 3, 1990

Nathan Mottl
Roy F. Weston Inc.
1 Weston Way Bldg. 51
West Chester, PA 19380

Dear Mr. Mottl:

In response to your telephone request, I am providing the following information:

Within a 5 km radius of the center of the Rocky Mountain Arsenal we are only aware of the ponds on the Arsenal as being open to public (although limited) fishing.

Within a 5-10 km radius, we have identified 7 ponds which are open to public fishing, four of which are at the same site. Here are the names and locations of the ponds:

Clear Creek Pond	Adams County	T3S, R68W, S2
Engineer's Lake	Adams County	T2S, R68W, S36
Rotella Park Pond	Adams County	T2S, R68W, S35
Grandview Ponds 1-4	Adams County	T2S, R67W, S18

Here is a summary of recent fish stocking information:

Clear Creek Pond - not stocked, but fish are present and fishing takes place

Engineer's Lake

1985: Stocked with 1100 4" Channel Catfish
1987: Stocked with 800 4" Largemouth Bass and 1500 6" Channel Catfish

Rotella Park Pond

1985: Stocked with 100 7" Bluegills

Grandview Pond #1

1988: Stocked with 20 15" Hybrid Grass Carp and 100 7" Largemouth Bass

Grandview Pond #2

1988: Stocked with 40 12" Hybrid Grass Carp and 200 7" Largemouth Bass

(continued)

Grandview Pond #3

1988: Stocked with 10 12" Hybrid Grass Garp and 100 7" Largemouth Bass

Grandview Pond #4

1988: Stocked with 20 12" Hybrid Grass Carp and 100 7" Largemouth Bass

The attached map shows the location of all 4 areas and provides some additional data - I have drawn in Grandview Ponds on it.

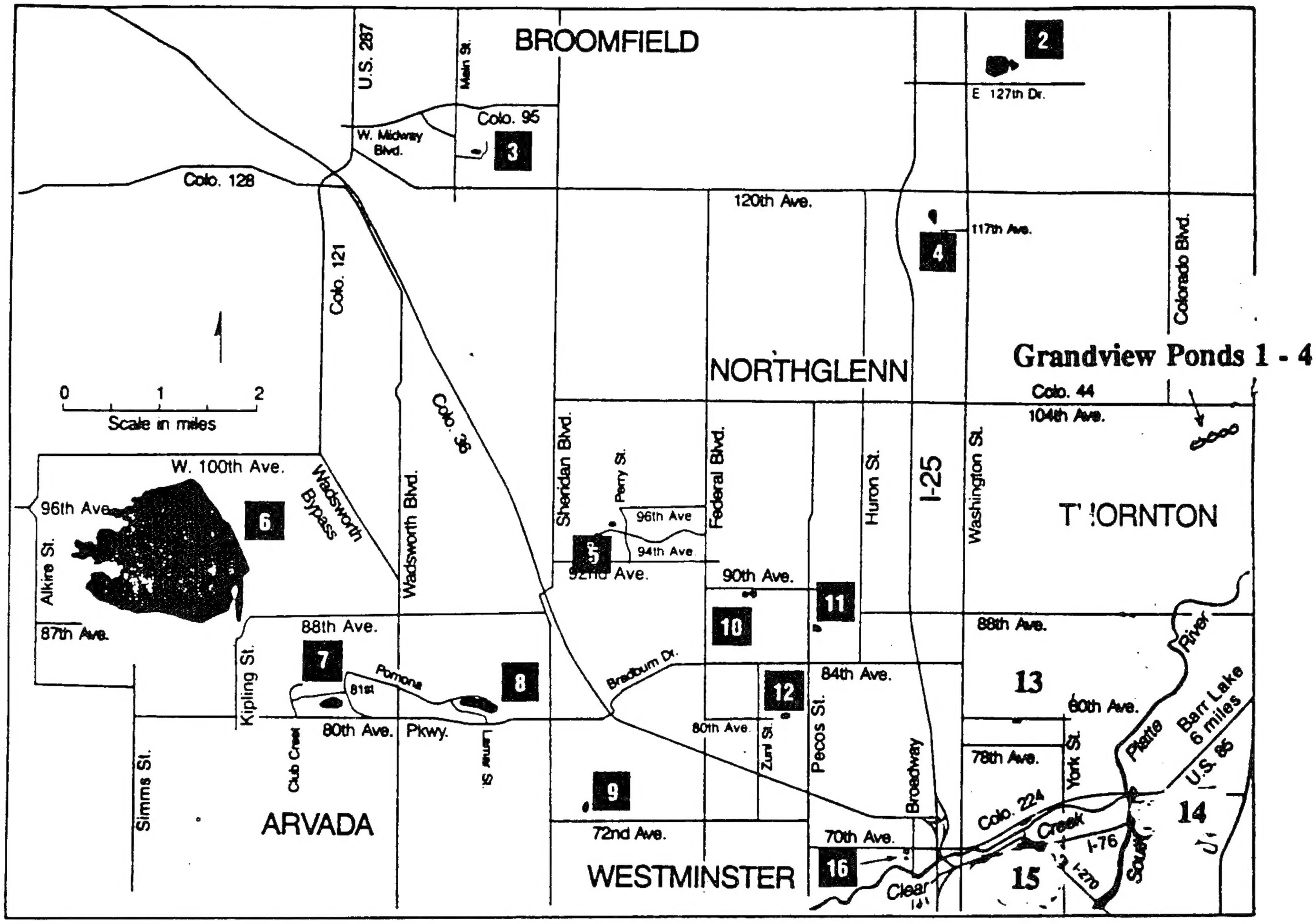
Let me know if you have any questions.

Sincerely,

Dave Weber

Dave Weber
Habitat Biologist

cc: Jim Satterfield, Pat Tucker



bass, yellow perch, and rainbow trout (catchable size stocked).

Agency: Adams County Parks & Recreation.

Comments: Open 5 a.m. to 11 p.m. No boats. Fishing pier on the south shore. Playground and restrooms. Extreme water level fluctuation. Hard surface foot trail.

5 Butts Park Pond

Location: Northwest of the intersection of W. 94th Ave. and Perry Street. Parking area is off of Perry Street just south of 96th Ave. or off of 94th Ave. next to the ice rink.

Size: 3 acres; 5 feet maximum depth.

Fish: Bluegill, bullhead, channel catfish, crappie, green sunfish, sucker, and yellow perch.

Agency: Hyland Hills Recreation & Park District.

Comments: Open daylight hours. No boats. Recreation Center and playground.

6 Standley Lake

Location: W. 88th Ave. and Kipling Street. Parking area is off of Kipling. Access also on the west side of the lake via Alkire Street at 87th Ave.

Size: 1,210 acres; 80 feet maximum depth.

Fish: Bluegill, carp, channel catfish, green sunfish, largemouth bass, smallmouth bass, sucker, walleye, yellow perch, and rainbow trout (catchable size stocked).

Agency: South and southwest shore, Jefferson County Open Space. Remaining shore and lake itself, City of Westminster Parks & Recreation.

Comments: Open 5 a.m. to 11 p.m. for walk-in visitors. Open 8 a.m. to 7 p.m. for vehicles and boats. All boats need Westminster boat permit. Fee area for vehicles at Kipling & W. 88th Ave. Walk-in fishing is free. Extreme water level fluctuation. Two boat ramps on east shore. No fishing from dam.

MAY BE CLOSED DUE TO INSURANCE PROBLEMS: CONTACT MANAGING AGENCY.

7 Pomona Lake,

Location: In Meadow Glen Park. North of W. 80th Ave. and one-quarter mile west of Wadsworth Blvd. Main parking area can be reached via 80th Ave. by going north on Club Crest Drive, and then east on W. 81st Place.

Size: 31 acres; 8 feet maximum depth.

Fish: Largemouth bass, yellow perch, bullhead, channel catfish, crappie, and green sunfish.

Agency: North Jeffco Parks & Recreation.

Comments: Open dawn to 11 p.m. No boats. Hard surface foot trail.

8 Lake Arbor

Location: North of W. 80th Ave. between Wadsworth Blvd. and Sheridan Blvd. Both the north and south shores of the lake can be reached via 80th Ave. To reach the south shore, take 80th Ave. to Lamar Street. Go north on Lamar to 80th Place. Take 80th Place east to the cul-de-sac. To reach the north shore take Lamar Street north past 80th Place on to Pomona Drive. Go east on Pomona around the north end of the lake to the parking area.

Size: 37 acres, 19 feet maximum depth.

Fish: Bluegill, bullhead, carp, channel catfish, crappie, green sunfish, largemouth bass, pumpkinseed sunfish, and sucker. Grass carp stocked to control aquatic plants.

Agency: North Jeffco Recreation & Park District and City of Arvada.

Comments: Open dawn to 11 p.m. Non-motorized boats only. Fishing piers located on the north shore. Artificial fish habitat structures in lake. Playground. Hard surface foot trail.

9 Faversham Park Pond

Location: Sheridan and 72nd Ave.

Size: 6 acres; 11 feet maximum depth.

Fish: Bluegill.

Agency: City of Westminster Parks & Recreation.

Comments: Open sunrise to 11 p.m. No boats. No wading or swimming. Kids 15 years old and under.

10 Camenisch Park Pond

Location: West of Pecos Street, south of W. 90th Ave. at Fontaine Street. Parking area south of 90th Ave.

Size: 3 acres; 10 feet maximum depth.

Fish: Largemouth bass, pumpkinseed sunfish, sucker, bluegill, bullhead, channel catfish, crappie, and green sunfish.

Agency: Hyland Hills Recreation & Park District.

Comments: Open dawn to 10 p.m. No boats. Playground and restrooms. Hard surface foot trail.

11 Bell Roth Park Pond

Location: On the east side of Pecos Street, 2 blocks north of W. 84th Ave.

Size: 3 acres; 8 feet maximum depth.

Fish: Channel catfish, crappie, green sunfish, sucker, yellow perch, bluegill, bullhead, and carp.

Agency: Hyland Hills Recreation & Park District.

Comments: Open dawn to 10 p.m. No boats. Playground.

12 Kiwanis Park Pond

Location: W. 80th Ave. east of Zuni Street. Parking area south of 80th Ave.

Size: 3 acres; 2 feet maximum depth.

Fish: Bullhead and green sunfish.

Agency: Hyland Hills Recreation & Park District.

Comments: Open dawn to half hour after sunset. No boats.

13 Rotella Park Pond

[illegible] North of E. 78th Ave. between N. Washington Street and N. York Street. Parking north of 78th Ave. or south of Coronado Drive So.

Size: 3 acres; 10 feet maximum depth.

Fish: Bluegill, bullhead, channel catfish, largemouth bass, and pumpkinseed sunfish.

Agency: Adams County Parks.

Comments: Open 7 a.m. to 11 p.m. No boats. Extreme water level fluctuation. Playground and restrooms. Hard surface foot trail.

14 Engineers Lake

Location: From I-76 go to Hwy 224. Travel west on 224. Parking area is south of 224, just west of the South Platte River. The lake is at the confluence of Clear Creek and the South Platte River. Hard surface foot trail across the river.

Size: 11 acres; 25 feet maximum depth.

Fish: Bullhead

Agency: Adams County Parks & Recreation.

Comments: Open 7 a.m. to 11 p.m. No boats. Walk-in trail and steep shoreline. Picnic shelter.

15 Clear Creek Pond

[illegible] South of Hwy 224 between Washington Street and York Street. Parking area is south of Hwy 224, and east of Washington Street.

Size: 3 acres; 9 feet maximum depth.

Fish: Bluegill, bullhead, carp, channel catfish, crappie, green sunfish, largemouth bass, pumpkinseed sunfish, and yellow perch.

Agency: Adams County Parks & Recreation.

Comments: Open 7 a.m. to 11 p.m. No boats. Hard surface trail along south side of pond.

16 Twin Lakes Park Ponds

Location: Just west of Broadway on 70th Ave. Parking area south from 70th Ave.

Size: 2 ponds; 7 acres total; 16 feet maximum depth.

Fish: Bullhead, carp, channel catfish, crappie, green sunfish, largemouth bass, sucker, and yellow perch.

Agency: Adams County Parks.

Comments: Open 7 a.m. to 11 p.m. No boats. Hard surface foot trail, which connects with Clear Creek Trail.

17 Arvada Reservoir (not shown on map)

Location: Between Highway 93 and Indiana on W. 66th Ave.

Size: 180 acres; 77 feet maximum depth.

Fish: Rainbow trout, walleye, largemouth bass, smallmouth bass, yellow perch.

Agency: City of Arvada

Comments: City of Arvada permit required; available only at Arvada City Hall. No ice fishing. Non-motorized boats only. Open dawn to dusk. Special regulations apply.

18 Carl Park Pond

Location: West of Federal Blvd., on W. 54th Ave. at Meade Street. Parking area north of 54th Ave.

Size: 4 acres; 8 feet maximum depth.

Fish: Largemouth bass, bluegill, and bullhead.

Agency: Hyland Hills Recreation & Park District.

Comments: Open dawn to 10 p.m. No boats.

19 Birdland Lake

Location: W. 51st Ave. and Garrison Street. Parking area west of Garrison at south end of the lake.

Size: 3 acres; 10 feet maximum depth.

Fish: Bluegill, channel catfish, green sunfish, largemouth bass, pumpkinseed sunfish, and yellow perch.

Agency: North Jeffco Recreation & Park District.

Comments: Open dawn to 11 p.m. Non-motorized boats only. No ice fishing. Playground and hard surface foot trail.

20 Ward Road Pond

Location: Northeast of the intersection of I-70 and Ward Road. Parking area east of Ward Road and south of W. 48th Ave.

Size: 7 acres; 30 feet maximum depth.

Fish: Largemouth bass, pumpkinseed, bluegill, bullhead, crappie, and green sunfish.

Agency: City of Arvada and Division of Wildlife.

Comments: Non-motorized boats only. Belly-boats allowed. Pond open for fishing only. Good bass fishing. Restrooms.

Special Regulations: 1. Fishing by artificial flies or artificial lures only; 2. All fish caught must be returned to the water immediately

New Ponds Not Yet In Guide

Lowell Ponds - Adams County- At Lowell Street and 56th Way

Size: 3 ponds - 11 acres, 2 acres, 2 acres + Sheets Lake, 5 acres leased from City of Westminster. Maximum Depth - 10 feet.

Fish: Largemouth and smallmouth bass, channel catfish, bluegill, crappie and bullhead.

Agency: Colorado Division of Wildlife

Comments: Belly boats allowed for fishing, except on Sheets Lake.

Special Regulation: All largemouth and smallmouth bass possessed must be 15 inches or longer.

Ketner Lake - Jefferson County - Off of 100th Ave. and County Side Drive

Size: 25 acres

Agency: City of Westminster

Fish: Largemouth bass, crappie, bluegill, green sunfish, yellow perch and bullhead

Comments: Belly boats allowed for fishing but no other types of boats. Ice fishing is prohibited. Special Regulation: All largemouth & smallmou[illegible] bass possessed must be 15 inches or longer.

Grandview Ponds Adams County - Off of 104th and Riverdale Road

~~Size~~. 4 ponds - 10 acres total

Agency: Colorado Division of Wildlife

Fish: Largemouth bass, bluegill, channel catfish, crappie, bullhead green sunfish and yellow perch.

Special Regulation: All largemouth and smallmouth bass possessed m[illegible] be 15 inches or longer.

Adams County Fairgrounds Lake (Public Works Lake) - Adams County - Off of 124th at Adams County Fairgrounds.

Size: 20 acres

Agency: Adams County Parks and Recreation

Fish: Largemouth bass, blurgill, channel catfish, crappie and yellow perch.

Special Regulation: All largemouth and smallmouth bass possessed must be 15 inches or longer.

Boating Changes

Cottonwood Park Lake - Page 9 - No boating is allowed.
Kendrick Reservoir - Page 9 - No boating is allowed
Quincy Reservoir - Page 12 - Boat rental available
Own boat allowed with Aurora permit - Non-motorized boats only
Waneka Lake - Page 14 - Boat rental now available

Phone Number Changes

Bear Creek Reservoir - 987-7880
Chatfield Reservoir - 791-7275
Foothills Parks & Recreation - 987-3602

AGENCY CHANGES

Webster Lake - Page 4 - Agency: City of Northglenn
Main Reservoir - Page 9 - Agency: Lakewood Department of Community Resources
East Reservoir - Page 9 - Agency: Lakewood Department of Community Resources
Smith Reservoir - Page 9 - Agency: Lakewood Department of Community Resources
Kendrick Reservoir - Page 9 - Agency: Foothills Parks & Recreation
Teller Lake - Page 14 - Agency: City of Boulder Open Space

FISH SPECIES ADDITIONS

Barr Lake - Page 4 - Tiger Muskie
Standley Lake - Page 5 - Wiper
Overland Park Pond - Page 8 - Bullhead
Bear Creek Reservoir - Page 9 - Tiger Muskie
Chatfield Reservoir - Page 11 - Walleye
Cherry Creek Reservoir - Page 11 & 12 - Wiper & Tiger Muskie
Quincy Reservoir - Page 12 - Tiger Muskie
Gross Reservoir - Page 15 & 16 - Tiger Muskie
Evergreen Lake - Page 23 - Tiger Muskie

BAG AND POSSESSION LIMITS FOR SPECIFIC FISH

Some waters of the state have more restrictive catch limitations than those listed below. Be sure to check the Colorado fishing regulations before fishing any water.

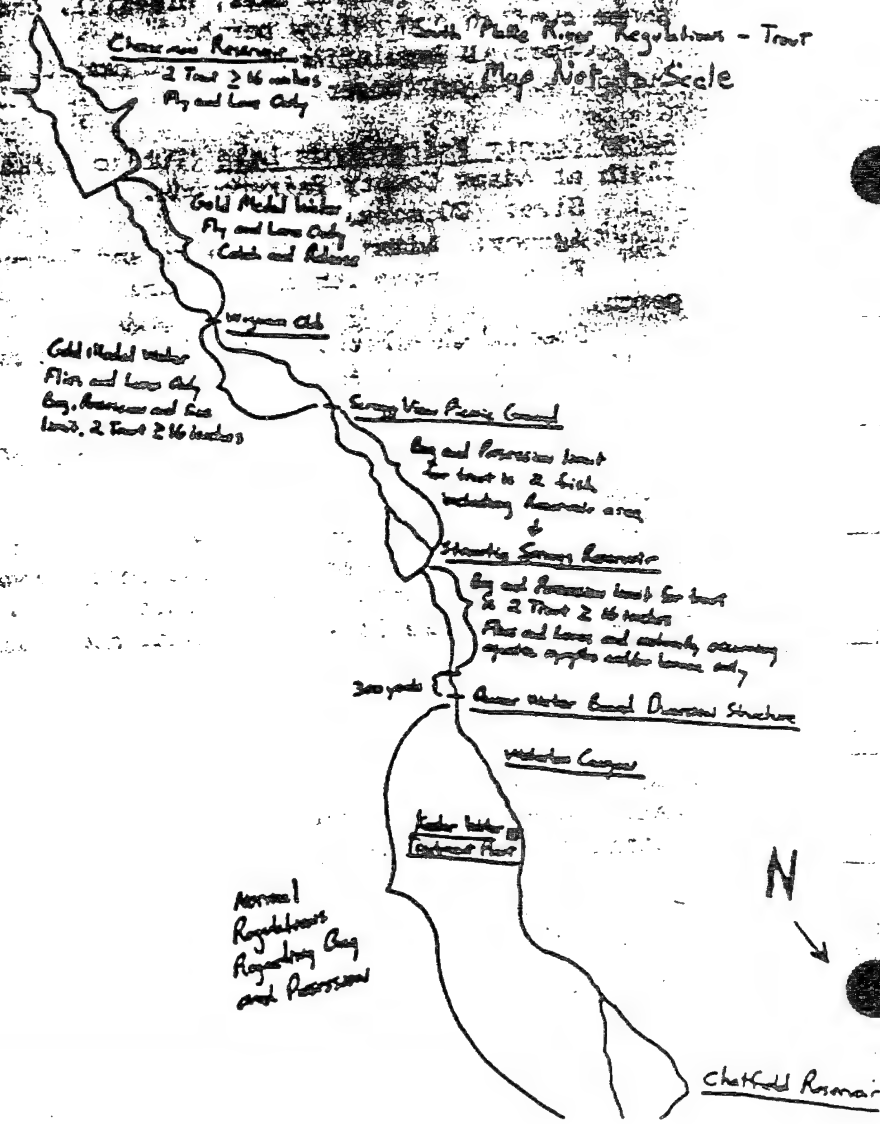
SPECIES		DAILY BAG LIMITS	POSSESSION LIMITS
Rainbow Trout Brown Trout Brook Trout Cutthroat Trout Golden Trout Lake Trout Arctic Char Grayling Coho Salmon	in aggregate*	8	8

*"In aggregate" means the limit may consist of one species or may be a mixed bag of more than one species.

IN ADDITION TO THE ABOVE DESCRIBED EIGHT FISH DAILY BAG AND POSSESSION LIMITS FOR TROUT, A PERSON MAY TAKE INTO POSSESSION A FULL LIMIT OF EACH OF THE FOLLOWING FISH SPECIES.

Fish	Daily Bag	Possession Limit
Brook Trout 8 inches or less	10	10
Kokanee Salmon: Angling, Feb. 1-Aug. 31	10	10
Snagging or angling, Sept. 1-Jan. 31	40	40
Walleye [illegible]	[illegible]	20
Sauger	10	10
Smallmouth Bass [illegible]	[illegible]	10
Largemouth Bass	10	10
Spotted Bass [illegible]	10	10
Channel Catfish	10	10
[illegible]	[illegible]	10
White bass or wipers - Arkansas/Republican river drainages (excluding Bonny Reservoir) - 20 fish, in aggregate*, of which no more than 6 can be 20 inches or longer. South Platte Drainage, in aggregate*, 10 fish.		
[illegible]	[illegible]	20
Crappie	20	20
[illegible]	[illegible]	20
Northern Pike	20	20
Tiger Muskie [illegible]	One 36 inches or longer	
Crayfish (Crawdads)	No Limit	No Limit
Bullfrogs [illegible]	[illegible]	40
Salamander: Aquatic gilled form	120	120
Adult land form	6	6

There are no limits for game fish not listed above (excluding endangered).



APPENDIX 5A

DERIVATION OF EMISSION RATES FOR DIOXINS/FURANS AND THE INORGANICS

5A.1 INTRODUCTION

Once the pollutants are identified, the next step in identifying process emissions is to predict the mass of these pollutants emitted from the stack over time. Emission factors are used to predict or estimate the concentrations and emission rates of the pollutants likely to be emitted from proposed facilities or from facilities for which there are no emissions data. Emission factors account for variations in emissions with respect to facility capacities and stack gas conditions (i.e., moisture content, temperature, and excess air) so that they can be used to estimate likely emissions from a facility that is basically similar in design and operation. Therefore, it is important that the emission factors be developed from data for the specific waste to be burned or from emissions data from comparable operating facilities. This section presents the emission factors and the resulting emission rates for the identified pollutants and provides the basis for the selection of the emission factors.

5A.2 OVERVIEW

The current analyses of emissions for four separate groups of pollutants are reported in this section. These categories are: polychlorinated dibenzo-p-dioxins (dioxins or PCDDs) and polychlorinated dibenzofurans (furans or PCDFs); inorganics (trace metals); volatile and semi-volatile organics (including products of incomplete combustion (PICs) and principal organic hazardous constituents (POHCs); and criteria pollutants (for which national ambient air quality standards have been established) and acid gases. The emission factors for each category of pollutants were derived from several methods and were based on:

- The test burn data for the Basin F waste obtained by T-THERMAL in February 1989 and August 1990
- The expected waste feed rate and composition (based on previous Basin F sampling data) and published EPA control equipment removal efficiencies
- Federal and Colorado emission limitations
- Emission test data obtained from other hazardous waste incineration facilities (from WESTON's comprehensive database)

The first method used to estimate emissions was based on the test burn conducted by T-THERMAL in August 1990. This test burn was comprised of nine test runs performed on a pilot-scale incinerator, which burned Basin F liquid and hydrazine wastewater. Most of the test runs could not be used to develop emission factors because dried waste clogged the atomizing tip of the nozzle during testing. There were several methods used to remove the waste buildup from the nozzle tip. In some instances, a hammer was used to gently hit the injector tip. Another method was passing steam or high pressure atomizing air through the injector. During these periods, the waste, the atomizing air flow, and the sampling trains were shut down; however, discontinuities in emissions were likely. There were no equipment operating difficulties during test runs 4 and 8; therefore, only test runs 4 and 8 were used to develop emission factors for dioxins and furans. Test run 4 was used to develop emission factors for metals and other inorganics (criteria pollutants and acid gases). The averages of all the test runs, including the unacceptable ones, were considered in developing upper bound sensitivity case emission factors. Tables 5A-1 and 5A-2 describe the problems that occurred during organic and inorganic testing, respectively.

The second method used to estimate the emissions was based on the expected feed rate of the waste being incinerated. WESTON investigated, collected, and assembled previous analytical data on the Basin F liquids. Sources of information and test data included Rocky Mountain Arsenal, Woodward-Clyde Consultants, T-THERMAL, Waterway Experiment Station, Ebasco, and Shell Oil Company. Testing by these companies occurred from 1978 through 1989. WESTON also performed a series of tests on the pond and storage tanks in August and October 1989, and in February and April 1990. All of the test data were reviewed and converted into common units, parts per million by weight. Then the arithmetic mean and the maximum values were determined for each of the groups of data (historical Basin F, pond, and storage tanks). The maximum of the arithmetic means was determined by taking the highest value of the arithmetic means for the historical Basin F, pond, and storage tank data. Similarly, the maximum of the maximums was determined by taking the highest value of the maximums determined for each group of data. Table 5A-3 presents the basic analytical data and the averages and maximums for each group of data.

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Table 5A-1

Problems During Organic Testing

Test Date	Test Time	Sample Time (min)	Run Number	Problems During Testing
14-Aug-90	10:04 10:58	54	1	1.) 9:40 - Basin F liquid waste was introduced. 2.) 10:30 - rapping was performed on the nozzle to help reduce increasing CO levels. 3.) 10:34 - highest CO readings (301 ppmdv @ 7% O2).
14-Aug-90	15:30 16:31	56	2	1.) 15:05 - restarted the incinerator. 2.) 15:35, 16:00 & 16:05 - rapping was performed on the nozzle to help reduce CO levels. 3.) 16:05 & 16:20 - a shot of high pressure atomizing air was injected into the nozzle. 4.) 16:10 - the atomizing air temp. was increased to 200 F. 5.) 16:20 - the nozzle was lowered 1/2" further into into chamber. 6.) 16:05 - highest CO readings (212 ppmdv @ 7% O2).
15-Aug-90	08:45 09:25	32	3	1.) 8:30 - Basin F liquid waste was introduced. 2.) 9:00 & 9:30 - steam was injected through the nozzle. 3.) 9:11 - highest CO readings (183 ppmdv @ 7% O2).
16-Aug-90	08:55 12:08	180	4	1.) 8:46 - Basin F liquid waste was introduced. 2.) 9:45 - highest CO readings (212 ppmdv @ 7% O2).
16-Aug-90	12:51 17:09	180	5	1.) 12:22 - compressor went down 2.) 12:30 - Basin F liquid waste was introduced. 3.) 14:00 - the injectors were changed to help reduce high CO levels. 4.) 14:30 - Basin F liquid waste was introduced. 5.) 15:15, 16:15 & 17:10 - rapping was performed on the nozzle to help reduce CO levels. 6.) 13:06 - highest CO readings (319 ppmdv @ 7% O2).
16-Aug-90	18:10 21:43	180	6	1.) 17:40 - the waste interlock tripped due to low water levels in the venturi sump. 2.) 18:00 - Basin F liquid waste was introduced. 3.) 18:15, 20:30 & 21:00 - rapping was performed on the nozzle to help reduce CO levels. 4.) 18:12 - highest CO readings (258 ppmdv @ 7% O2).
17-Aug-90	08:02 11:29	120	7	1.) 7:41 - Basin F liquid waste was introduced. 2.) 8:03 - hydazine waste water was also introduced. 3.) 9:45 - the injectors were steamed for 10 minutes and the liquid was reintroduced after CO levels spiked over 100 ppm. Once the waste was reintroduced the O2 levels fell below 1.7% which automatically shutoff the waste. 4.) 10:00 - the injectors were replaced twice. 5.) 10:45 - the waste was reintroduced. 6.) 10:33 - highest CO readings (102 ppmdv @ 7% O2).
17-Aug-90	12:10 14:13	113	8	1.) 12:08 - rapping was performed on the nozzle to help reduce CO levels. 2.) 12:58 - highest CO readings (150 ppmdv @ 7% O2).
17-Aug-90	14:51 16:51	120	9	1.) 14:45, 15:35 & 16:11 - rapping was performed on the nozzle to help reduce CO levels. 2.) 15:30 - highest CO readings (227 ppmdv @ 7% O2).

Note:

Rapping - hitting the liquid pipe portion of the injector with a hammer to remove the dried waste clogging the atomizing air slots of the waste injector nozzle atomizing tip. It manifested itself by an increase in CO.

Other actions - passing steam or high pressure atomizing air throughout the passages of the injector. During these periods, the waste and the atomizing air flow was shutoff. Also the emission sampling trains were shut down.

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Table 5A-2

Problems During Metal Testing

Test Date	Test Time	Sample Time (min)	Run Number	Problems During Testing
14-Aug-90	10:17 10:58	29	1	1.) 9:40 - Basin F liquid waste was introduced. 2.) 10:30 - rapping was performed on the nozzle to help reduce increasing CO levels. 3.) 10:34 - highest CO readings (301 ppmdv @ 7% O2).
14-Aug-90	15:29 16:31	51	2	1.) 15:05 - restarted the incinerator. 2.) 15:35, 16:00 & 16:05 - rapping was performed on the nozzle to help reduce CO levels. 3.) 16:05 & 16:20 - a shot of high pressure atomizing air was injected into the nozzle. 4.) 16:10 - the atomizing air temp. was increased to 200 F. 5.) 16:20 - the nozzle was lowered 1/2" further into into chamber. 6.) 16:05 - highest CO readings (212 ppmdv @ 7% O2).
15-Aug-90	08:47 09:26	31	3	1.) 8:30 - Basin F liquid waste was introduced. 2.) 9:00 & 9:30 - steam was injected through the nozzle. 3.) 9:11 - highest CO readings (183 ppmdv @ 7% O2).
16-Aug-90	09:08 11:20	120	4	1.) 8:46 - Basin F liquid waste was introduced. 2.) 9:45 - highest CO readings (212 ppmdv @ 7% O2).
16-Aug-90	11:42 15:13	120	5	1.) 12:22 - compressor went down 2.) 12:30 - Basin F liquid waste was introduced. 3.) 14:00 - the injectors were changed to help reduce high CO levels. 4.) 14:30 - Basin F liquid waste was introduced. 5.) 15:15, 16:15 & 17:10 - rapping was performed on the nozzle to help reduce CO levels. 6.) 13:06 - highest CO readings (319 ppmdv @ 7% O2).
16-Aug-90	15:58 18:53	120	6	1.) 17:40 - the waste interlock tripped due to low water levels in the venturi sump. 2.) 18:00 - Basin F liquid waste was introduced. 3.) 18:15 - rapping was performed on the nozzle to help reduce CO levels. 4.) 18:12 - highest CO readings (258 ppmdv @ 7% O2).
16-Aug-90	19:09 21:27	120	7	1.) 20:30 & 21:00 - rapping was performed on the nozzle to help reduce CO levels. 2.) 20:28 - highest CO readings (356 ppmdv @ 7% O2).
17-Aug-90	08:07 11:55	120	8	1.) 7:41 - Basin F liquid waste was introduced. 2.) 8:03 - hydazine waste water was also introduced. 3.) 9:45 - the injectors were steamed for 10 minutes and the liquid was reintroduced after CO levels spiked over 100 ppm. Once the waste was reintroduced the O2 levels fell below 1.7% which automatically shutoff the waste. 4.) 10:00 - the injectors were replaced twice. 5.) 10:45 - the waste was reintroduced. 6.) 10:33 - highest CO readings (102 ppmdv @ 7% O2).
17-Aug-90	13:26 15:51	120	9	1.) 14:45 & 15:35 - rapping was performed on the nozzle to help reduce CO levels. 2.) 14:29 - highest CO readings (356 ppmdv @ 7% O2).

<u>Note:</u>

Rapping - hitting the liquid pipe portion of the injector with a hammer to remove the dried waste clogging the atomizing air slots of the waste injector nozzle atomizing tip. It manifested itself by an increase in CO.

Other actions - passing steam or high pressure atomizing air throughout the passages of the injector. During these periods, the waste and the atomizing air flow was shutoff. Also the emission sampling trains were shut down.

Table 5A-3

Chemical Characterization of Basin F Liquid

Compounds (*mg/L or ppm by wt.*)	Arithmetic Mean			Maximum of the Average	Maximum Value			Maximum of the Maximum
	History	*Pond*	*Tanks*		*History*	*Pond*	*Tanks*	
Volatiles								
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	1.5E-06	2.2E-01	2.2E-01	NA	1.5E-06	3.2E-01	3.2E-01
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	1.0E-05	1.0E-05	NA	NA	3.4E-05	3.4E-05
1,2-Dichloropropane	NA	NA	5.5E-01	5.5E-01	NA	NA	1.1E+00	1.1E+00
1,3-Dimethylbenzene	NA	NA	4.6E-02	4.6E-02	NA	NA	1.2E-01	1.2E-01
2-Chloroethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	1.9E+00	1.9E+00	NA	NA	1.9E+00	1.9E+00
Ammonia	5.8E+04	NA	NA	5.8E+04	7.2E+04	NA	NA	7.2E+04
Benzene	9.5E-03	1.3E-01	NA	1.3E-01	9.5E-03	1.3E-01	NA	1.3E-01
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	9.0E-03	NA	NA	9.0E-03	1.8E-02	NA	NA	1.8E-02
Carbon Tetrachloride	NA	1.5E-01	NA	1.5E-01	NA	1.5E-01	NA	1.5E-01
Chlorobenzene	NA	NA	4.0E-02	4.0E-02	NA	NA	1.1E-01	1.1E-01
Chloroform	2.5E-03	1.7E-01	2.6E-01	2.6E-01	3.1E-03	1.7E-01	3.5E-01	3.5E-01
Dicyclopentadiene	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenze	NA	NA	8.2E-02	8.2E-02	NA	NA	1.6E-01	1.6E-01
Methanol	NA	NA	4.7E+03	4.7E+03	NA	NA	4.7E+03	4.7E+03
Methylene Chloride	NA	NA	2.5E+00	2.5E+00	NA	NA	1.1E+01	1.1E+01
Tetrachlorethene	NA	NA	1.4E-01	1.4E-01	NA	NA	1.5E-01	1.5E-01
Toluene	9.1E-03	NA	2.3E-02	2.3E-02	9.8E-03	NA	4.2E-02	4.2E-02
Trichloroethene	NA	4.4E-01	6.9E-02	4.4E-01	NA	4.4E-01	1.1E-01	4.4E-01
Xylene (total)	NA	1.3E-01	2.6E-01	2.6E-01	NA	1.3E-01	9.9E-01	9.9E-01

Compounds (mg/L or ppm by wt.)	Arithmetic Mean			Maximum of the Average	Maximum Value			Maximum of the Maximum
	History	*Pond*	*Tanks*		*History*	*Pond*	*Tanks*	
Semivolatiles								
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenylmethylsulfone	1.0E-01	6.9E-02	1.4E-01	1.4E-01	2.5E-01	1.1E-01	3.0E-01	3.0E-01
4-Chlorophenylmethylsulfoxide	1.7E+01	NA	NA	1.7E+01	3.2E+01	NA	NA	3.2E+01
4-Nitrophenol	1.0E+01	NA	NA	1.0E+01	1.8E+01	NA	NA	1.8E+01
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	1.2E+00	NA	3.8E-01	1.2E+00	2.9E+00	NA	1.0E+00	2.9E+00
Atrazine	2.7E-01	NA	NA	2.7E-01	2.7E-01	NA	NA	2.7E-01
Cyanide	1.2E+00	NA	NA	1.2E+00	1.9E+00	NA	NA	1.9E+00
Dieldrin	2.6E-01	NA	NA	2.6E-01	5.7E-01	NA	NA	5.7E-01
Diisopropyl Methylphosphonate	4.3E+01	NA	NA	4.3E+01	1.5E+02	NA	NA	1.5E+02
Dimethyl Methylphosphonate	1.1E+03	NA	NA	1.1E+03	2.5E+03	NA	NA	2.5E+03
Dimethyldisulfide	1.2E+02	NA	8.4E+01	1.2E+02	1.5E+02	NA	8.4E+01	1.5E+02
Dimethylphosphate	NA	1.6E+02	2.9E+02	2.9E+02	NA	2.8E+02	8.2E+02	8.2E+02
Dithiane	4.3E-02	NA	NA	4.3E-02	1.2E-01	NA	NA	1.2E-01
Endrin	2.5E-01	NA	NA	2.5E-01	7.4E-01	NA	NA	7.4E-01
Hexachlorocyclopentadiene	2.3E+00	NA	NA	2.3E+00	2.3E+00	NA	NA	2.3E+00
Isodrin	6.5E-01	NA	NA	6.5E-01	2.5E+00	NA	NA	2.5E+00
Malathion	1.0E+00	NA	NA	1.0E+00	1.0E+00	NA	NA	1.0E+00
Parathion	1.4E-01	NA	NA	1.4E-01	1.4E-01	NA	NA	1.4E-01
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Supona	4.2E-01	NA	NA	4.2E-01	4.2E-01	NA	NA	4.2E-01
Urea	1.8E+05	NA	NA	1.8E+05	1.8E+05	NA	NA	1.8E+05
Vapona	1.1E+00	NA	NA	1.1E+00	1.1E+00	NA	NA	1.1E+00
ppDDE	1.4E-01	NA	NA	1.4E-01	1.4E-01	NA	NA	1.4E-01
ppDDT	4.2E-01	NA	NA	4.2E-01	4.2E-01	NA	NA	4.2E-01

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Table 5A-3
(Continued)

Compounds (*mg/L or ppm by wt.*)	Arithmetic Mean			Maximum of the Average	Maximum Value			Maximum of the Maximum
	History	*Pond*	*Tanks*		*History*	*Pond*	*Tanks*	
Metals								
Aluminum	4.2E+00	NA	NA	4.2E+00	5.5E+00	NA	NA	5.5E+00
Antimony	7.3E-01	NA	NA	7.3E-01	1.1E+00	NA	NA	1.1E+00
Arsenic	4.1E+00	NA	2.4E+00	4.1E+00	9.9E+00	NA	2.4E+00	9.9E+00
Barium	4.0E-01	NA	1.4E+00	1.4E+00	4.0E-01	NA	1.4E+00	1.4E+00
Boron	2.0E+01	NA	NA	2.0E+01	2.1E+01	NA	NA	2.1E+01
Cadmium	6.4E-04	4.6E-02	1.2E-01	1.2E-01	2.5E-03	7.5E-02	2.5E-01	2.5E-01
Calcium	1.8E+02	NA	NA	1.8E+02	3.3E+02	NA	NA	3.3E+02
Chloride	1.3E+05	NA	NA	1.3E+05	2.0E+05	NA	NA	2.0E+05
Chromium	1.2E+00	NA	1.4E+00	1.4E+00	1.9E+00	NA	1.4E+00	1.9E+00
Cobalt	9.0E-01	NA	NA	9.0E-01	9.3E-01	NA	NA	9.3E-01
Copper	3.8E+03	1.9E+03	3.0E+03	3.8E+03	7.3E+03	3.1E+03	7.0E+03	7.3E+03
Fluoride	1.1E+02	NA	NA	1.1E+02	2.1E+02	NA	NA	2.1E+02
Iron	5.5E+01	NA	NA	5.5E+01	9.3E+01	NA	NA	9.3E+01
Lead	1.3E+00	NA	1.2E+00	1.3E+00	2.5E+00	NA	1.2E+00	2.5E+00
Magnesium	1.6E+02	NA	NA	1.6E+02	2.7E+02	NA	NA	2.7E+02
Manganese	7.0E+00	NA	NA	7.0E+00	7.2E+00	NA	NA	7.2E+00
Mercury	2.3E-01	NA	7.4E-02	2.3E-01	3.4E-01	NA	7.4E-02	3.4E-01
Molybdenum	2.5E+00	NA	NA	2.5E+00	2.6E+00	NA	NA	2.6E+00
Nickel	3.3E+01	NA	NA	3.3E+01	3.4E+01	NA	NA	3.4E+01
Nitrate	1.3E+03	NA	NA	1.3E+03	1.3E+03	NA	NA	1.3E+03
Nitrogen	6.9E+04	NA	NA	6.9E+04	1.0E+05	NA	NA	1.0E+05
Phosphorus (total)	2.0E+04	NA	NA	2.0E+04	8.6E+04	NA	NA	8.6E+04
Potassium	1.3E+03	NA	NA	1.3E+03	2.9E+03	NA	NA	2.9E+03
Selenium	NA	NA	2.1E+03	2.1E+03	NA	NA	2.1E+03	2.1E+03
Silver	NA	NA	5.4E+02	5.4E+02	NA	NA	5.4E+02	5.4E+02
Sodium	5.3E+04	4.1E+04	1.3E+05	1.3E+05	8.1E+04	8.8E+04	3.3E+05	3.3E+05
Sulfate	3.5E+04	NA	NA	3.5E+04	5.8E+04	NA	NA	5.8E+04
Vanadium	2.7E+00	NA	NA	2.7E+00	3.0E+00	NA	NA	3.0E+00
Zinc	1.9E+01	1.6E+01	1.4E+01	1.9E+01	2.7E+01	3.8E+01	2.0E+01	3.8E+01
Total				6.4E+05				1.0E+06

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Table 5A-3
(Continued)

Compounds (mg/L or ppm by wt.)	Arithmetic Mean			Maximum of the Average	Maximum Value			Maximum of the Maximum
	History	Pond	Tanks		History	Pond	Tanks	
Parameters								
Alkalinity	1.8E+03	NA	NA		2.0E+03	NA	NA	
COD	1.7E+05	NA	NA		2.3E+05	NA	NA	
Conductivity, μmhos/cm	1.1E+05	NA	NA		1.1E+05	NA	NA	
Hardness	3.0E+03	NA	NA		3.5E+03	NA	NA	
Specific Gravity	1.2E+00	NA	NA		1.2E+00	NA	NA	
TOC	5.3E+04	NA	NA		1.2E+05	NA	NA	
Total Organic Halide (TOX)	4.1E+02	NA	NA		5.7E+02	NA	NA	
Total Suspended Solids	1.3E+03	NA	NA		1.6E+03	NA	NA	
Viscosity 10° C, cp	3.6E+00	NA	NA		3.8E+00	NA	NA	
Viscosity 15° C, cp	3.0E+00	NA	NA		3.1E+00	NA	NA	
Viscosity 20° C, cp	2.6E+00	NA	NA		2.6E+00	NA	NA	
Viscosity 25° C, cp	2.2E+00	NA	NA		2.3E+00	NA	NA	
Viscosity 2° C, cp	4.8E+00	NA	NA		5.0E+00	NA	NA	
pH	6.1E+00	NA	NA		7.2E+00	NA	NA	

NA = Not available (i.e., not analyzed or not detected)

For certain inorganics, the maximum of the arithmetic mean and maximum of the maximum waste feed values were used to estimate the expected (i.e., base case) and reasonable worst case (i.e., sensitivity case) emissions, respectively. For metals, the volatilization and removal efficiencies for the individual elements were based on the Guidance on Metals and HCl Controls from Hazardous Waste Incineration (EPA, 1989). For acid gases, criteria, and other inorganic pollutants, conversion and removal efficiencies were based on regulatory requirements, the literature, and data for similar pollutants.

The maximum of the arithmetic means in the waste feed were the basis of expected emission estimates for volatile and semi-volatile organics other than dioxins/furans. Destruction efficiencies and PIC formation rates were estimated by Dr. Barry Dellinger of the University of Dayton Research Institute and were based on the results of his experimental studies. Dr. Dellinger's report is presented as Appendix 5B.

The third method used to estimate emissions was based on Tier II guideline emission levels given by the EPA (1989). Tier II metal emission guidelines were developed for complex and noncomplex terrain, urban and rural areas. These guidelines were developed as emission levels that would generate acceptable concentrations of metals from the perspective of inhalation health risk such that a more refined risk analysis would not be required. The sum of the ratios of the expected total emission rates of carcinogenic metals (arsenic, beryllium, cadmium, and chromium) to the Tier II carcinogenic metals emission rates must not exceed 1.0, or more refined dispersion modeling and risk assessment must be conducted. These Tier II levels were not applicable to this facility because more refined modeling and risk assessment were conducted; however, the Tier II values were used to develop the sensitivity case emission rates for metals.

The fourth method used to determine emission factors was based on a comprehensive database of air emissions from waste burning facilities developed by WESTON. The database contains information compiled from 12 hazardous waste incineration facilities. Because there is wide variation among these facilities in terms of incinerator design, processing capacities, stack gas conditions, combustion conditions, and other parameters,

emission factors, which are independent of these parameters, are used to standardize emissions data. Emission factors are usually calculated as the mass emissions per unit weight of waste processed (e.g., pounds of pollutant per ton of waste processed), or as the mass emissions per standardized stack gas volume (e.g., nanograms per normal cubic meter of stack gas). This is in contrast to the emission rates that are reported in units of mass emission per unit of time (e.g., grains per second or pounds per hour). Consequently, emission factors can be used to estimate the emission rates for facilities that may be similar in concept, but that may vary in design and operation. The sensitivity case for dioxins and furans was based on the 95 percent confidence interval (log normal of the mean) of the emission factors calculated for the facilities in the database.

5A.3 DIOXIN/FURAN EMISSIONS

5A.3.1 Expected Emissions

The Rocky Mountain Arsenal predicted air contaminant emissions from the proposed hazardous waste incinerator system were determined by performing test burns of the waste. T-THERMAL performed nine source tests of the waste in a pilot incinerator in August 1990. Table 5A-4 shows the dioxin/furan emission results of the individual test runs converted into nanograms per dry Normal (32°F) cubic meter corrected to 12 percent CO_2 (ng/Nm^3, dry @ 12 percent CO_2). During the series of tests, dried waste accumulated on the atomizing tip of the waste injector nozzle . As described in detail in Table 5A-1, procedures were taken to remove the waste. Because these injector clogging problems prevented normal incinerator operating conditions, many of the test runs were excluded; only test runs 4 and 8 were used to determine the base case in estimating the expected emission rates at the proposed RMA facility. A statistical analysis of all of the test runs and of test runs 4 and 8 alone is presented in Table 5A-5. The variation is much less for test runs 4 and 8.

The dioxin and furan concentrations were then converted into toxic equivalence factors (TEF). The TEF is the currently acceptable method for evaluating such emissions, and is a weighing scheme in which the measured congeners of dioxins and furans are normalized

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Tab[illegible]A-4

Dioxin Emissions Test Burn Results

(ng/Nm^3, dry @ 12% CO_2)

Dioxins/Furans	Test Runs 1	2	3	4	5	6	7	8	9
2,3,7,8-TCDF	0.226	0.173	0.104	0.146	0.149	0.139	0.138	0.112	0.122
Total TCDF	1.075	0.778	0.424	0.644	0.639	0.617	0.630	0.495	0.581
2,3,7,8-TCDD	0.008	0.011	0.015	0.003	0.003	0.003	0.004	0.004	0.004
Total TCDD	0.046	0.059	0.017	0.043	0.024	0.003	0.042	0.060	0.023
1,2,3,7,8-PeCDF	0.042	0.032	0.018	0.024	0.025	0.028	0.025	0.022	0.025
2,3,4,7,8-PeCDF	0.721	0.059	0.034	0.055	0.051	0.065	0.051	0.045	0.044
Total PeCDF	0.635	0.460	0.254	0.369	0.349	0.424	0.367	0.350	0.366
1,2,3,7,8-PeCDD	0.001	0.001	0.002	0.000	0.000	0.000	0.001	0.001	0.001
Total PeCDD	0.015	0.027	0.002	0.006	0.008	0.005	0.009	0.023	0.032
1,2,3,4,7,8-HxCDF	0.087	0.047	0.040	0.061	0.055	0.062	0.053	0.027	0.029
1,2,3,6,7,8-HxCDF	0.072	0.038	0.024	0.036	0.031	0.037	0.029	0.024	0.023
1,2,3,7,8,9-HxCDF	0.069	0.060	0.053	0.043	0.039	0.043	0.040	0.037	0.037
2,3,4,7,8,9-HxCDF	0.007	0.008	0.008	0.004	0.004	0.006	0.004	0.004	0.003
Total HxCDF	0.613	0.345	0.197	0.267	0.238	0.262	0.246	0.211	0.220
1,2,3,4,7,8-HxCDD	0.003	0.002	0.006	0.001	0.001	0.001	0.001	0.002	0.001
1,2,3,6,7,8-HxCDD	0.007	0.008	0.013	0.003	0.003	0.002	0.003	0.004	0.003
1,2,3,7,8,9-HxCDD	0.007	0.008	0.010	0.003	0.004	0.002	0.003	0.003	0.004
Total HxCDD	0.037	0.058	0.121	0.029	0.042	0.032	0.013	0.022	0.046
1,2,3,4,6,7,8-HpCDF	0.009	0.012	0.081	0.094	0.081	0.084	0.075	0.064	0.070
1,2,3,4,7,8,9-HpCDF	0.020	0.020	0.013	0.011	0.014	0.015	0.012	0.009	0.011
Total HpCDF	0.089	0.064	0.093	0.133	0.128	0.131	0.115	0.092	0.099
1,2,3,4,6,7,8-HpCDD	0.129	0.159	0.340	0.061	0.051	0.054	0.068	0.043	0.087
Total HpCDD	0.248	0.605	1.272	0.198	0.200	0.174	0.126	0.080	0.180
OCDF	0.098	0.096	0.059	0.473	0.081	0.077	0.063	0.042	0.056
OCDD	1.614	1.872	5.723	1.031	0.766	1.080	1.089	0.660	1.161
U.S.EPA TEF	0.422	0.081	0.070	0.065	0.061	0.069	0.062	0.052	0.053

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Table 5A-5
Dioxin Emissions Test Burn Results
(ng/Nm^3, dry @ 12% CO_2)

Dioxins/Furans	All Test Runs			Runs 4 & 6			Emission
	Average	Standard Deviation	Standard Error	Average	Standard Deviation	Standard Error	Rate (lb/hr)
2,3,7,8-TCDF	0.145	0.037	0.253	0.129	0.024	0.186	2.62E-09
Total TCDF	0.654	0.187	0.286	0.570	0.106	0.185	1.16E-08
2,3,7,8-TCDD	0.006	0.004	0.688	0.004	0.001	0.255	7.64E-11
Total TCDD	0.035	0.020	0.553	0.051	0.012	0.230	1.05E-09
1,2,3,7,8-PeCDF	0.027	0.007	0.251	0.023	0.001	0.045	4.65E-10
2,3,4,7,8-PeCDF	0.125	0.224	1.788	0.050	0.007	0.140	1.03E-09
Total PeCDF	0.397	0.105	0.265	0.360	0.014	0.038	7.32E-09
1,2,3,7,8-PeCDD	0.001	0.001	0.836	0.001	0.001	1.414	1.13E-11
Total PeCDD	0.014	0.011	0.758	0.015	0.012	0.822	2.99E-10
1,2,3,4,7,8-HxCDF	0.051	0.019	0.362	0.044	0.024	0.551	8.86E-10
1,2,3,6,7,8-HxCDF	0.035	0.015	0.435	0.030	0.008	0.271	6.13E-10
1,2,3,7,8,9-HxCDF	0.047	0.011	0.245	0.040	0.005	0.116	8.10E-10
2,3,4,7,8,9-HxCDF	0.005	0.002	0.325	0.004	0.000	0.054	8.68E-11
Total HxCDF	0.289	0.129	0.446	0.239	0.039	0.163	4.87E-09
1,2,3,4,7,8-HxCDD	0.002	0.002	0.806	0.002	0.001	0.519	3.30E-11
1,2,3,6,7,8-HxCDD	0.005	0.004	0.685	0.004	0.001	0.255	7.64E-11
1,2,3,7,8,9-HxCDD	0.005	0.003	0.537	0.003	0.000	0.054	6.51E-11
Total HxCDD	0.044	0.032	0.712	0.025	0.005	0.183	5.18E-10
1,2,3,4,6,7,8-HpCDF	0.063	0.031	0.493	0.079	0.021	0.269	1.61E-09
1,2,3,4,7,8,9-HpCDF	0.014	0.004	0.272	0.010	0.002	0.170	2.05E-10
Total HpCDF	0.105	0.024	0.225	0.113	0.029	0.260	2.29E-09
1,2,3,4,6,7,8-HpCDD	0.110	0.094	0.856	0.052	0.012	0.237	1.06E-09
Total HpCDD	0.342	0.380	1.109	0.139	0.084	0.602	2.83E-09
OCDF	0.116	0.135	1.162	0.257	0.305	1.183	5.24E-09
OCDD	1.666	1.568	0.941	0.845	0.262	0.310	1.72E-08
U.S.EPA TEF	0.104	0.120	1.152	0.058	0.009	0.154	1.19E-09

or weighted by their toxicity relative to that of a single congener (i.e., 2,3,7,8-tetrachloro-dibenzo-p-dioxin [2,3,7,8-TCDD]). This congener is the most studied and most toxic congener. Table 5A-6 illustrates the international weighing scheme adopted by the EPA.

5A.3.2 Upper Bound Emissions

For the sensitivity or upper bound case, data on hazardous waste facilities from the WESTON comprehensive database were used. Unfortunately, most of the available dioxin and furan data compiled from these facilities lacked the information required to calculate TEFs. In a number of cases, only amounts of total PCDD and PCDF, and frequently of total tetrachlorinated dibenzo-p-dioxin (TCDD) and total tetrachlorinated dibenzofuran (TCDF) homologues are reported along with the 2,3,7,8-TCDD congener, if detected.

In order to deal most effectively with this absence of data and the need to establish TEFs, the following process was used:

- TEFs were calculated for the available data sets. Because most of the facility tests measured all congener groups needed to calculate the TEF, the available data were used in conjunction with ratios of homologue emissions to TCDD emissions and of 2,3,7,8-substituted emissions of a homologue to the total emissions of the homologue in order to establish TEF emissions for each facility. The ratios of emissions used were calculated from emission test data for municipal solid waste (MSW) incinerators (Siebert et al., 1989). These ratios are conservatively higher (from a risk assessment perspective) than the theoretical splits based on the possible number of congeners.

- Geometric mean and confidence intervals of the mean based on a log normal distribution of estimated TEF values were used to establish the range of TEF emissions. A log normal distribution was assumed among facilities because it is common for emissions data and has been demonstrated for dioxin/furan TEF emissions from MSW incinerators (Siebert et al., 1988).

This approach would not be the preferred approach if more congener-specific data were available; however, it is considered the most appropriate approach in light of the limited quantity and quality of the available data.

Table 5A-6

U.S. EPA 2,3,7,8-TCDD Toxic Equivalency Factors (TEFs)[1]

Homologue/Congener[2]	TEF[3]
Mono through trichloro dibenzo-p-dioxins and dibenzofurans	0
2,3,7,8-TCDD	1
Other TCDDs	0
2,3,7,8-PeCDD	0.5
Other PeCDDs	0
2,3,7,8-HxCDDs	0.1
Other HxCDDs	0
2,3,7,8-HpCDDs	0.01
Other HpCDDs	0
OCDDs	0.001
2,3,7,8-TCDF	0.1
Other TCDFs	0
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
Other PeCDFs	0
2,3,7,8-HxCDFs	0.1
Other HxCDFs	0
2,3,7,8-HpCDFs	0.01
Other HpCDFs	0
OCDFs	0.001

[1] Source: Bellin J.S., and D.G. Barnes, "Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans and 1989 Update", U.S. EPA Risk Assessment Forum, EPA/625/3-89/016, March 1989.

[2] The following abbreviations are used for dioxin/furan homologues and congeners:

<u>Homologues</u>

TCDD	-	tetrachlorinated dibenzo-p-dioxin (4 chlorines)
PeCDD	-	pentachlorinated dibenzo-p-dioxin (5 chlorines)
HxCDD	-	hexachlorinated dibenzo-p-dioxin (6 chlorines)
HpCDD	-	heptachlorinated dibenzo-p-dioxin (7 chlorines)
OCDD	-	octachlorinated dibenzo-p-dioxin (8 chlorines)
TCDF	-	tetrachlorinated dibenzo-furans (4 chlorines)
PeCDF	-	pentachlorinated dibenzo-furans (5 chlorines)
HxCDF	-	hexachlorinated dibenzo-furans (6 chlorines)
HpCDF	-	heptachlorinated dibenzo-furans (7 chlorines)
OCDF	-	octachlorinated dibenzo-furans (8 chlorines)

<u>Congeners</u>

2,3,7,8	=	2,3,7,8-substituted congeners of homologue.
Other	=	All congeners of homologue other than the 2,3,7,8-substituted congeners.

[3] TEF = Toxic equivalency factor.

Several key points need to be made about all the dioxin/furan data used to establish emissions and its applicability to the RMA incinerator:

- A number of the facilities used in the analysis burn significantly different wastes than those to be burned in the RMA incinerator. In fact, many of the tested incinerators burn large quantities of PCBs. Although the formation mechanisms for dioxins/furans are not clearly understood, the presence of PCBs or other likely dioxin/furan precursors in the waste stream would probably tend to increase dioxin/furan emissions.

- The data sets used in this analysis generally were not taken directly from original comprehensive test reports, but from partial results reported in the literature. This makes standardization of the data difficult.

- An inherent assumption is that the homologue/TCDD ratios and 2,3,7,8/total homologue ratios are relatively consistent for municipal solid waste and hazardous waste incineration.

Table 5A-7 summarizes the EPA toxic equivalent data for each facility and the resulting geometric mean and confidence interval. Also displayed is a summary of the T-THERMAL test results for all the tests, the acceptable tests, the emission rate in pounds per hour (lb/hr) based upon the % CO_2, the actual temperature and the moisture content of the flue gas during the trial burns of the Basin F waste, and the expected flue gas flow rate for the full-scale submerged quench incinerator proposed for RMA. The emission rates, which were used for the base case, were the average of the acceptable test run from the trial burn of the RMA-Basin F waste, while those used for the sensitivity case were the upper 95 percent confidence limit of test results from facilities in the WESTON database.

5A.4 INORGANICS EMISSIONS

5A.4.1 Expected Emissions

Emission factors for metals and other inorganics (such as criteria pollutants and acid gases) were derived by several methods. For the base case or expected emissions, the maximum value was selected from the acceptable test burn emission results and the emissions derived from the maximum average concentration of metals in the waste feed to the incinerator,

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Table 5A-7

Summary of Dioxin/Furan Toxic Equivalent Emissions from the Hazardous Waste Incinerators

Facility	U.S. EPA TEF Emission Factor (ng/Nm^3 @ 12% CO2)	Rate (lbs/hr)
Ross	0.048	
American Cyanamid	0.054	
DuPont	0.044	
UpJohn	0.104	
Mitchell	0.236	
Plant B (Outlet Location)	7.295	
SCA	0.872	
Rollins (Deer Park, Texas)	1.519	
ENSCO	0.103	
Rollins (Bridgeport, New Jersey)	0.620	
Biebesheim	1.050	
Geometric Mean	0.300	6.11E-09
Upper 95% Confidence Interval	0.931	1.90E-08
Lower 95% Confidence Interval	0.097	1.97E-09
Rocky Mountain Arsenal		
All Tests	0.104	2.11E-09
Acceptable Tests	0.058	1.19E-09

$$\frac{ng}{Nm^3}, dry @ 12\% CO2 \times 4.72 \frac{m^3}{sec} \times \frac{(273.15)N\ °C}{(394.30)A\ °C} \times \frac{(10.10)A\ \%\ CO2}{12\%\ CO2} \times \frac{(100 - 6.74)\ moist}{100} \times \frac{lb}{453.6*10^9\ ng} \times \frac{3600\ sec}{hr}$$

assuming that the volatilization fraction and the efficiencies of the air pollution control (APC) equipment are equal to those given by EPA.

For the first approach, the test burn data were converted into emission factors in pounds of metal and other inorganics per ton of waste incinerated (lb/ton) and evaluated to see if the operating conditions were representative of the expected RMA submerged quench incinerator conditions. Table 5A-8 illustrates the results of the converted test burn data for metals. As displayed in Table 5A-2, upset conditions occurred during every test run except test run 4; therefore it is considered acceptable and representative of the expected conditions. Table 5A-9 presents a statistical analysis of all the test runs and compares the results with test run 4 alone.

The second approach was based on information regarding the concentrations of metals and other inorganics in the waste feed. The calculations for metals are given in Table 5A-9. The uncontrolled emissions are based on the maximum average concentrations from each of the historical tests of the Basin F waste and the series of tests WESTON performed both on the tanks and on the pond. The results were converted into lb/ton based on the density of the waste.

The controlled emission rate was based on expected feed rate, the percent of metals volatilized (and subsequently condensed and adsorbed onto particles), and the removal efficiency of the air pollution control equipment. After identifying the input of waste stream metals, the next step was to determine the fractions of those metals that would be expected to volatilize and later condense and adsorb onto particles. This adsorption process is necessary for the collection of metals by the air pollution control (APC) system. Based on EPA (1989), all metals in liquid waste will volatilize during combustion.

Removal efficiencies (considering both adsorption and collection) were estimated for a packed scrubber in series with a 60-inch pressure drop Venturi scrubber in the incinerator APC system. EPA (1989) only provided efficiency values for selected metals controlled by

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Table 5A-8

Metal Emissions Test Burn Results
(lb/ton)

Metals	Test Runs 1	2	3	4	5	6	7	8	9
Silver	1.26E-05	7.04E-06	1.29E-05	3.38E-06	2.70E-06	3.34E-06	2.88E-06	3.34E-06	3.33E-06
Aluminum	1.80E-03	1.49E-03	1.67E-03	9.98E-04	1.22E-03	1.03E-03	1.24E-03	1.26E-03	1.74E-03
Arsenic	2.85E-05	2.18E-05	3.87E-05	9.46E-06	8.78E-06	9.36E-06	9.37E-06	1.00E-05	9.98E-06
Boron	3.82E-03	2.57E-03	1.16E-03	1.48E-03	1.38E-03	1.92E-03	5.23E-04	2.42E-03	2.81E-03
Barium	2.06E-05	4.93E-06	3.50E-05	4.87E-05	5.40E-06	6.02E-06	4.83E-05	1.67E-06	1.66E-06
Beryllium	8.62E-06	4.93E-06	9.12E-06	2.03E-06	2.03E-06	2.01E-06	2.16E-06	2.50E-06	2.49E-06
Calcium	2.22E-03	1.81E-03	4.79E-03	3.61E-03	5.07E-03	9.00E-03	9.76E-03	7.21E-03	6.00E-03
Cadmium	7.30E-06	2.11E-06	2.28E-06	6.76E-07	6.75E-07	1.34E-06	7.21E-07	8.34E-07	8.31E-07
Cobalt	3.98E-06	2.11E-06	3.80E-06	6.76E-07	6.75E-07	6.69E-07	NA	8.34E-07	8.31E-07
Chromium	7.30E-06	4.22E-06	7.60E-06	2.03E-06	2.03E-06	2.01E-06	2.16E-06	1.67E-06	1.66E-06
Copper	6.89E-04	4.33E-03	3.40E-03	2.10E-02	1.46E-02	5.67E-03	4.90E-03	2.83E-03	2.43E-03
Iron	1.45E-03	4.19E-04	1.60E-03	5.15E-04	9.33E-04	4.86E-03	3.89E-04	5.84E-05	9.81E-05
Mercury	1.26E-05	7.04E-06	1.29E-05	3.38E-06	2.70E-06	3.34E-06	2.88E-06	3.34E-06	3.33E-06
Potassium	1.23E-03	7.35E-04	1.29E-03	3.20E-04	2.99E-04	3.10E-04	3.19E-04	3.34E-04	3.39E-04
Lithium	2.45E-05	1.48E-05	2.58E-05	6.08E-06	6.08E-06	6.02E-06	6.49E-06	6.67E-06	6.65E-06
Magnesium	6.30E-04	7.32E-05	3.37E-03	3.88E-03	3.32E-03	9.22E-03	1.11E-02	6.63E-03	4.63E-03
Manganese	3.18E-03	8.30E-05	8.36E-05	5.61E-05	4.46E-05	4.01E-06	3.60E-06	1.67E-06	1.66E-06
Molybdenum	1.26E-05	7.04E-06	1.29E-05	3.38E-06	2.70E-06	3.34E-06	2.88E-06	3.34E-06	3.33E-06
Sodium	9.69E-01	2.46E+00	2.60E+02	3.59E+00	2.93E+00	2.23E+00	2.23E+00	1.60E+00	1.18E+00
Nickel	2.84E-04	7.04E-06	1.29E-05	3.38E-06	2.70E-06	3.34E-06	2.88E-06	3.34E-06	3.33E-06
Phosphorus	3.67E-03	5.77E-03	2.97E-02	9.80E-02	8.14E-02	4.44E-02	3.70E-02	1.99E-02	1.93E-02
Lead	3.71E-04	1.48E-05	3.36E-04	6.08E-06	6.08E-06	6.02E-06	6.49E-06	6.67E-06	6.65E-06
Sulfur	1.24E+01	7.79E-03	5.69E-02	9.82E-02	7.87E-02	4.71E-02	3.38E-02	2.16E-02	2.16E-02
Antimony	2.45E-05	1.48E-05	5.94E-04	6.08E-06	6.08E-06	6.02E-06	6.49E-06	6.67E-06	6.65E-06
Selenium	2.25E-05	2.18E-05	1.55E-03	9.46E-06	8.78E-06	5.22E-04	9.37E-06	1.00E-05	4.75E-04
Silicon	2.54E-02	1.30E-02	2.12E-02	8.76E-03	5.11E-03	7.13E-03	7.43E-03	3.79E-03	2.44E-03
Tin	1.36E-04	1.48E-05	2.07E-03	4.48E-04	4.19E-04	4.33E-04	4.46E-04	6.67E-06	4.07E-04
Strontium	8.62E-06	2.11E-06	3.80E-06	2.03E-06	6.75E-07	4.01E-06	3.60E-06	1.67E-06	1.66E-06
Titanium	1.46E-05	7.04E-06	1.29E-05	3.38E-06	2.70E-06	3.34E-06	2.88E-06	3.34E-06	3.33E-06
Thallium	3.71E-05	2.18E-05	2.33E-03	5.12E-04	4.19E-04	5.26E-04	9.37E-06	1.00E-05	4.07E-04
Vanadium	2.65E-06	1.41E-06	2.28E-06	6.76E-07	6.75E-07	6.69E-07	7.21E-07	8.34E-07	8.31E-07
Yttrium	1.33E-06	7.04E-07	1.52E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	4.93E-04	8.83E-03	3.15E-04	2.72E-04	2.36E-04	1.69E-04	8.51E-05	1.48E-04	1.37E-04

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Table 5A-9

Metals Emissions Test Burn Results
(lb/ton)

Metals	All Test Runs Average	Standard Deviation	Standard Error	Run 4 (lb/ton)	Run 4 (lb/hr)
Silver	5.72E-06	4.19E-06	0.7322	3.38E-06	1.74E-05
Aluminum	1.38E-03	3.03E-04	0.2189	9.98E-04	5.15E-03
Arsenic	1.62E-05	1.10E-05	0.6760	9.46E-06	4.88E-05
Boron	2.01E-03	1.0E-03	0.4976	1.48E-03	7.65E-03
Barium	1.91E-05	1.98E-05	1.0369	4.87E-05	2.51E-04
Beryllium	3.99E-06	2.92E-06	0.7315	2.03E-06	1.05E-05
Calcium	5.50E-03	2.79E-03	0.5070	3.61E-03	1.87E-02
Cadmium	1.86E-06	2.13E-06	1.1433	6.76E-07	3.49E-06
Cobalt	1.70E-06	1.46E-06	0.8590	6.76E-07	3.49E-06
Chromium	3.41E-06	2.42E-06	0.7092	2.03E-06	1.05E-05
Copper	6.65E-03	6.68E-03	1.0045	2.10E-02	1.08E-01
Iron	1.15E-03	1.50E-03	1.3046	5.15E-04	2.66E-03
Mercury	5.72E-06	4.19E-06	0.7322	3.38E-06	1.74E-05
Potassium	5.76E-04	4.13E-04	0.7178	3.20E-04	1.65E-03
Lithium	1.15E-05	8.27E-06	0.7214	6.08E-06	3.14E-05
Magnesium	4.76E-03	3.66E-03	0.7693	3.88E-03	2.00E-02
Manganese	3.84E-04	1.05E-03	2.7296	5.61E-05	2.90E-04
Molybdenum	5.72E-06	4.19E-06	0.7322	3.38E-06	1.74E-05
Sodium	3.08E+01	8.58E+01	2.7906	3.59E+00	1.85E+01
Nickel	3.59E-05	9.31E-05	2.5946	3.38E-06	1.74E-05
Phosphorus	3.77E-02	3.26E-02	0.8647	9.80E-02	5.06E-01
Lead	8.44E-05	1.53E-04	1.8103	6.08E-06	3.14E-05
Sulfur	1.41E+00	4.11E+00	2.9031	9.82E-02	5.07E-01
Antimony	7.46E-05	1.95E-04	2.6128	6.08E-06	3.14E-05
Selenium	2.92E-04	5.17E-04	1.7687	9.46E-06	4.88E-05
Silicon	1.05E-02	7.95E-03	0.7594	8.76E-03	4.52E-02
Tin	4.87E-04	6.22E-04	1.2778	4.48E-04	2.31E-03
Strontium	3.13E-06	2.35E-06	0.7504	2.03E-06	1.05E-05
Titanium	5.95E-06	4.63E-06	0.7785	3.38E-06	1.74E-05
Thallium	4.74E-04	7.30E-04	1.5400	5.12E-04	2.64E-03
Vanadium	1.19E-06	7.62E-07	0.6385	6.76E-07	3.49E-06
Yittrium	1.18E-06	4.26E-07	0.3604	NA	NA
Zinc	1.19E-03	2.87E-03	2.4168	2.72E-04	1.40E-03

a packed scrubber in series with a 20-inch pressure drop Venturi scrubber and a 20-inch or 60-inch pressure drop Venturi scrubber alone. Therefore, the removal efficiency of the packed scrubber was calculated and added to the removal efficiency of the 60-inch pressure drop Venturi scrubber. It should be noted, that it was conservatively assumed that no metals were removed in the incinerator quench pit; similarly, no metals in the waste feed or in the flue gas entering the APC devices were assumed to be removed. Several documents provided information for conservatively estimating removal efficiencies of the metals not noted in EPA (1989), based on the efficiencies given in EPA (1989). The detailed assumptions and results of this approach are presented in Table 5A-10.

For acid gases, criteria, and other inorganic pollutants, the same two approaches were used. However, the controlled emissions based on the waste stream data considered the conversion of the waste stream component to its emitted chemical form and assumed removal efficiencies based on a number of sources. The basis of the assumed removal efficiencies included regulatory requirements, literature values, and data for similar pollutants. The base case expected emissions analysis (along with the sensitivity case maximum upper bound analysis) is presented in Table 5A-11.

5A.4.2 Upper Bound Emissions

The upper bound emissions or sensitivity case for metals and other inorganics was based upon the average of all runs during the test burn, the maximum controlled emission rate based on the waste feed data, and in the case of metals, the EPA Tier II values. The highest value of those generated by these three approaches was used.

The first approach for estimating the upper bound emissions was based on the average of all the runs from the test burn (acceptable or not). The second approach was based on the highest of the maximum waste feed rate values and the volatilization and removal efficiency methodology applied to the expected feed rate, explained in the previous section. Table 5A-12 presents the assumptions and results of these two approaches for metals. The assumptions and results for other inorganics are given in Table 5A-11.

Table 5A-10

Expected Metal Emissions Based on Test Burn Emissions and Waste Stream Data

Metals	Based on Waste Stream Data: Uncontrolled Emissions (1) (lb/ton)	Based on Waste Stream Data: Metals to APCD (2) (%)	Based on Waste Stream Data: Removal Efficiency (3) (%)	Based on Waste Stream Data: Controlled Emissions (4) (lb/ton)	Based upon Acceptable Test Burn Data: Controlled Emissions (5) (lb/ton)	Maximum Emissions Between the Two Scenarios (lb/ton)	Maximum Emissions Between the Two Scenarios (lb/hr)
Aluminum	6.7E-03	100	97 (6)	2.02E-04	9.98E-04	9.98E-04	5.15E-03
Antimony	1.2E-03	100	97	3.51E-05	6.08E-06	3.51E-05	1.81E-04
Arsenic	6.6E-03	100	97	1.99E-04	9.46E-06	1.99E-04	1.03E-03
Barium	2.3E-03	100	99.4	1.37E-05	4.87E-05	4.87E-05	2.51E-04
Beryllium	NA	100	99.4	NA	2.03E-06	2.03E-06	1.05E-05
Boron	3.2E-02	100	97 (8)	9.68E-04	1.48E-03	1.48E-03	7.65E-03
Cadmium	1.9E-04	100	97	5.78E-06	6.76E-07	5.78E-06	2.98E-05
Calcium	2.8E-01	100	97 (7)	8.51E-03	3.61E-03	8.51E-03	4.39E-02
Chromium	2.3E-03	100	99.4	1.37E-05	2.03E-06	1.37E-05	7.05E-05
Cobalt	1.5E-03	100	97 (6)	4.37E-05	6.76E-07	4.37E-05	2.25E-04
Copper	6.2E+00	100	97 (6)	1.86E-01	2.10E-02	1.86E-01	9.59E-01
Iron	8.8E-02	100	97 (6)	2.64E-03	5.15E-04	2.64E-03	1.36E-02
Lead	2.1E-03	100	97	6.22E-05	6.08E-06	6.22E-05	3.21E-04
Lithium	NA	100	NA	NA	6.08E-06	6.08E-06	3.14E-05
Magnesium	2.6E-01	100	97 (6)	7.90E-03	3.88E-03	7.90E-03	4.08E-02
Manganese	1.1E-02	100	97 (6)	3.41E-04	5.61E-05	3.41E-04	1.76E-03
Mercury	3.7E-04	100	85	5.50E-05	3.38E-06	5.50E-05	2.84E-04
Molybdenum	4.1E-03	100	85 (6)	6.11E-04	3.38E-06	6.11E-04	3.15E-03
Nickel	5.3E-02	100	97 (6)	1.58E-03	3.38E-06	1.58E-03	8.18E-03
Potassium	2.1E+00	100	97 (7)	6.29E-02	3.20E-04	6.29E-02	3.25E-01
Selenium	3.4E+00	100	85 (6)	5.09E-01	9.46E-06	5.09E-01	2.63E+00
Silicon	NA	100	NA	NA	8.76E-03	8.76E-03	4.52E-02
Silver	8.8E-01	100	99.4	5.27E-03	3.38E-06	5.27E-03	2.72E-02
Sodium	2.2E+02	100	97 (9)	6.47E+00	3.59E+00	6.47E+00	3.34E+01
Strontium	NA	100	97 (8)	NA	2.03E-06	2.03E-06	1.05E-05
Thallium	NA	100	97	NA	5.12E-04	5.12E-04	2.64E-03
Tin	NA	100	97 (7)	NA	4.48E-04	4.48E-04	2.31E-03
Titanium	NA	100	97 (6)	NA	3.38E-06	3.38E-06	1.74E-05
Vanadium	4.3E-03	100	97 (6)	1.29E-04	6.76E-07	1.29E-04	6.68E-04
Yittrium	NA	100	97 (8)	NA	NA	0.00E+00	0.00E+00
Zinc	3.0E-02	100	97 (6)	9.01E-04	2.72E-04	9.01E-04	4.65E-03

(1) Based upon the maximum of the averages emission concentration from historical test data (tons/yr) and multiplying by 2000 lbs/ton / ((10,325 lbs of waste/hr / 2000 lbs/ton) x 7,000 operating hrs/yr).

(2) Percent of metal volatilization is estimated at 100% for all metals in liquid waste based on EPA Guidance on Metals and HCl Controls from Hazardous Waste Incineration, Draft Final Report, August 1989, Table III-9.

(3) Based on EPA Guidance (note 2), Table III-8. The removal efficiency of the wet scrubber in series with the Venturi scruuber at 20" of water was calculated. This removal efficiency was used in series with the removal efficiency of the Venturi scrubber at 60" of water.

(4) Controlled Emissions = Uncontrolled Emissions x % Metals to APCD x (1- % Removal Efficiency)

(5) Based upon the emissions during the one acceptable test run from the test burn by T-Thermal in Aug. 1990.

(6) Assumed removal efficiency of antimony, arsenic, cadmium, lead and thallium or of mercury per footnote (3), based on scrubber efficiency similar to those compounds in "Hazardous Waste Stream Trace Metal Concentrations and Emissions", Mitre Corp., U.S.EPA Office of Solid Waste, November 1983.

(7) Similar to copper, cobalt and titanium in showing no concentration with particle size per Davision, Natusch, et al. "Trace Elements in Fly Ash", Environmental Science & Technology, Vol. 8, No. 13, December 1974. Therefore, assumed scrubber efficiency similar.

(8) Similar emissions to feed ratio to that of iron and aluminum per Kaakinen Jorden, et al., "Trace Element Behavior in Coal-Fired Power Plant", Environmental Science & Technology, Vol. 9, No. 9, September 1975. Therefore, assumed scrubber efficiency similar.

(9) Similar control efficiency to that of calcium, iron and potassium per Klein, Andren, et al., "Pathways of Thirty-seven Trace Elements Through Coal-Fired Power Plant", Environmental Science & Technology, Vol. 9, No. 10, October 1975. Therefore, assumed scrubber efficiency similar.

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Table 5A-11

Expected Acid and Other Compounds Emissions Based on Test Burn Emissions and Waste Stream Data

Original Pollutant	Based on Waste Stream Data: Waste Feedrate (1) (lb/ton)	Converted Pollutant	Uncontrolled Emissions (2) (lb/ton)	Removal Efficiency (%)	Controlled Emissions (3) (lb/ton)	Based upon Acceptable Test Burn Data: Controlled Emissions (4) (lb/ton)	Maximum Emissions Between the Two Scenarios (5) (lb/ton)	(lb/hr)
Particulate Matter (PM)	NA	PM	NA	NA	NA	NA	NA	4.00 (6)
Carbon Monoxide (CO)	NA	CO	NA	NA	NA	NA	NA	4.00 (6)
Chloride (Cl)	215.5	HCl	221.7	95	11.1	0.261	0.261	1.35
Fluoride (F)	0.18	HF	0.2	95	0.009	NA	NA	1.35 (8)
Nitrate (NO3)	2.1	HNO3	2.1	90	0.213	NA	0.009	0.05
Nitrogen (N)	110.5	NO2	362.9	0	362.9	NA	0.213	1.10
Phosphorus (P)	31.7	PO4	31.7	99.4	0.190	1.778	1.778	9.18
Sulfate (SO4)	56.4	H2SO4	57.6	99	0.6	0.098	0.190	0.98
Sulfur (S)	NA	SO2	NA	90	NA	NA	0.58	2.97
						NA	NA	6.98 (8)

Maximum Acid and other Compound Emissions Based on Test Burn Emissions and Waste Stream Data

Original Pollutant	Based on Waste Stream Data: Waste Feedrate (1) (lb/ton)	Converted Pollutant	Uncontrolled Emissions (2) (lb/ton)	Removal Efficiency (%)	Controlled Emissions (3) (lb/ton)	Based upon Test Burn Data: Controlled Emissions (4) (lb/ton)	Maximum Emissions Between the Two Scenarios (5) (lb/ton)	(lb/hr)
Particulate Matter (PM)	NA	PM	NA	NA	NA	NA	NA	4.00 (6)
Carbon Monoxide (CO)	NA	CO	NA	NA	NA	0.403 (7)	0.403	2.08
Chloride (Cl)	318.0	HCl	327.1	95	16.4	NA	NA	4.00 (9)
Fluoride (F)	0.34	HF	0.4	95	0.018	NA	0.018	0.09
Nitrate (NO3)	2.1	HNO3	2.1	90	0.213	NA	0.213	1.10
Nitrogen (N)	168.4	NO2	553.0	0	553.0	NA	NA	40.92 (9)
Phosphorus (P)	138.7	PO4	138.7	99.4	0.832	0.038	0.832	4.30
Sulfate (SO4)	94.0	H2SO4	96.0	99	1.0	NA	0.96	4.96
Sulfur (S)	NA	SO2	NA	90	NA	NA	NA	29.00 (9)

(1) Based upon the maximum of the averages emission concentration and the maximum of the maximums emission concentration from historical test data (tons/yr) and for expected and maximum emissions, respectively, multiplying by 2000 lbs/ton / ((10,325 lbs of waste/hr / 2000 lbs/ton) x 7,000 operating hrs/yr).
(2) Based upon the waste feed rate x the molecular weight of the converted pollutant the molecular weight of the orginal pollutant.
(3) Controlled Emissions = Uncontrolled Emissions x (1- % Removal Efficiency)
(4) Based upon the average emission during the test burn by T-Thermal in Aug. 1990.
(5) The maximum values were used for all pollutants, except NO2, for which the test burn data was used, and otherwise noted.
(6) Particulate matter is based upon Colorado regulations of 0.08 gr/dscf @ 12% CO2.
(7) Carbon monoxide is based upon Federal regulations of 100 ppm.
(8) Based upon February 1989 test burn which tested for the specific compounds.
(9) [illegible]d upon vendor performance guarantees.

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Table 5A-12

Maximum Metal Emissions Based on Test Burn Emissions and Waste Stream Data

Metals	Based on Waste Stream Data: Uncontrolled Emissions (1) (lb/ton)	Metals to APCD (2) (%)	Removal Efficiency (3) (%)	Controlled Emissions (4) (lb/ton)	Based upon Test Burn Data: Controlled Emissions (5) (lb/ton)	Maximum Emissions Between the Two Scenarios (lb/ton)	(lb/hr)
Aluminum	8.9E-03	100	97 (6)	2.66E-04	1.38E-03	1.38E-03	7.14E-03
Antimony	1.8E-03	100	97	5.32E-05	7.46E-05	7.46E-05	3.85E-04
Arsenic	1.6E-02	100	97	4.80E-04	1.62E-05	4.80E-04	2.48E-03
Barium	2.3E-03	100	99.4	1.37E-05	1.91E-05	1.91E-05	9.87E-05
Beryllium	NA	100	99.4	NA	3.99E-06	3.99E-06	2.06E-05
Boron	3.4E-02	100	97 (8)	1.02E-03	2.01E-03	2.01E-03	1.04E-02
Cadmium	4.0E-04	100	97	1.20E-05	1.86E-06	1.20E-05	6.19E-05
Calcium	5.4E-01	100	97 (7)	1.62E-02	5.50E-03	1.62E-02	8.36E-02
Chromium	3.1E-03	100	99.4	1.84E-05	3.41E-06	1.84E-05	9.49E-05
Cobalt	1.5E-03	100	97 (6)	4.50E-05	1.70E-06	4.50E-05	2.32E-04
Copper	1.2E+01	100	97 (6)	3.52E-01	6.65E-03	3.52E-01	1.82E+00
Iron	1.5E-01	100	97 (6)	4.50E-03	1.15E-03	4.50E-03	2.32E-02
Lead	4.0E-03	100	97	1.20E-04	8.44E-05	1.20E-04	6.20E-04
Lithium	NA	100	NA	NA	1.15E-05	1.15E-05	5.92E-05
Magnesium	4.4E-01	100	97 (6)	1.32E-02	4.76E-03	1.32E-02	6.81E-02
Manganese	1.2E-02	100	97 (6)	3.48E-04	3.84E-04	3.84E-04	1.98E-03
Mercury	5.5E-04	100	85	8.23E-05	5.72E-06	8.23E-05	4.25E-04
Molybdenum	4.2E-03	100	85 (6)	6.29E-04	5.72E-06	6.29E-04	3.25E-03
Nickel	5.5E-02	100	97 (6)	1.65E-03	3.59E-05	1.65E-03	8.49E-03
Potassium	4.7E+00	100	97 (7)	1.40E-01	5.76E-04	1.40E-01	7.24E-01
Selenium	3.4E+00	100	85 (6)	5.09E-01	2.92E-04	5.09E-01	2.63E+00
Silicon	NA	100	NA	NA	1.05E-02	1.05E-02	5.41E-02
Silver	8.8E-01	100	99.4	5.27E-03	5.72E-06	5.27E-03	2.72E-02
[illegible]tum	5.3E+02	100	97 (9)	1.60E+01	3.08E+01	3.08E+01	1.59E+02
[illegible]ontium	NA	100	97 (8)	NA	3.13E-06	3.13E-06	1.62E-05
Thallium	NA	100	97	NA	4.74E-04	4.74E-04	2.45E-03
Tin	NA	100	97 (7)	NA	4.87E-04	4.87E-04	2.51E-03
Titanium	NA	100	97 (6)	NA	5.95E-06	5.95E-06	3.07E-05
Vanadium	4.8E-03	100	97 (6)	1.45E-04	1.19E-06	1.45E-04	7.49E-04
Yittrium	NA	100	97 (8)	NA	1.18E-06	1.18E-06	6.11E-06
Zinc	6.2E-02	100	97 (6)	1.85E-03	1.19E-03	1.85E-03	9.54E-03

(1) Based upon the maximum of the maximums emission concentration from historical test data (tons/yr) and multiplying by 2000 lbs/ton / ((10,325 lbs of waste/hr / 2000 lbs/ton) x 7,000 operating hrs/yr).

(2) Percent of metal volatilization is estimated at 100% for all metals in liquid waste based on EPA Guidance on Metals and HCl Controls from Hazardous Waste Incineration, Draft Final Report, August 1989, Table III-9.

(3) Based on EPA Guidance (note 2), Table III-8. The removal efficiency of the wet scrubber in series with the Venturi scruuber at 20" of water was calculated. This removal efficiency was used in series with the removal efficiency of the Venturi scrubber at 60" of water.

(4) Controlled Emissions = Uncontrolled Emissions x % Metals to APCD x (1- % Removal Efficiency)

(5) Based upon the average emission during the test burn by T-Thermal in Aug. 1990.

(6) Assumed removal efficiency of antimony, arsenic, cadmium, lead and thallium or of mercury per footnote (3), based on scrubber efficiency similar to those compounds in "Hazardous Waste Stream Trace Metal Concentrations and Emissions", Mitre Corp., U.S.EPA Office of Solid Waste, November 1983.

(7) Similar to copper, cobalt and titanium in showing no concentration with particle size per Davision, Natusch, et al. "Trace Elements in Fly Ash", Environmental Science & Technology, Vol. 8, No. 13, December 1974. Therefore, assumed scrubber efficiency similar.

(8) Similar emissions to feed ratio to that of iron and aluminum per Kaakinen Jorden, et al., "Trace Element Behavior in Coal-Fired Power Plant", Environmental Science & Technology, Vol. 9, No. 9, September 1975. Therefore, assumed scrubber efficiency similar.

(9) Similar control efficiency to that of calcium, iron and potassium per Klein, Andren, et al., "Pathways of Thirty-seven Trace Elements Through Coal-Fired Power Plant", Environmental Science & Technology, Vol. 9, No. 10, October 1975. Therefore, assumed scrubber efficiency similar.

The third approach for estimating upper bound metal emissions was used for all the metals listed in EPA (1989). This approach derived emission factors from the Tier I Feed Rate and Tier II Emission Rate screening values in (EPA 1989). Tier I and II values represent limits on feed and emission rates of metals to the incinerator that EPA has proposed as one part of its national performance standards for hazardous waste incinerator emissions. These Tier I and II screening values are designed to provide a simple and conservatively protective approach to regulating metals emissions (from a health risk perspective) and do not consider any reduction in emissions from metals either not volatilized or captured in the air pollution control equipment.

The EPA screening limits are based on conservatively low estimates of potential ambient air dispersion (i.e., resulting in higher ambient concentrations than normally expected for a given emission rate). Therefore, the specific appropriate values are dependent on key dispersion modeling parameters such as terrain, urban or rural area, and effective terrain-adjusted stack height. The dispersion modeling for the RMA incinerator unit assumed complex terrain, rural land use, and the following stack parameters: height of 28.96 meters (m), temperature of 449.8 K, and flow rate of 7.3 m^3/sec. From Table B-1 of EPA (1989), the predicted plume rise for these stack parameters is 7m.

Considering the measured terrain elevations used in the dispersion modeling in the original analysis, the terrain-adjusted effective stack height per Table B, Step 3 of EPA (1989) is:

Terrain-adjusted Stack Height = stack height + plume rise

= (maximum elevation - base elevation)

= 28.96m + 7m - (58.5m -0m) = -22.54m

Since the terrain-adjusted stack height is less than zero, the minimum terrain-adjusted stack height in the EPA tables of 4 meters was assumed. The Tier I feed rates in pounds per hour for complex terrain, rural land use, and a 4-meter, terrain-adjusted stack height from EPA (1989) are given for all listed metals in Table 5A-13.

Table 5A-13

Stack Parameters and Tier I Expected and Maximum Feed Rates for Complex Terrain

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Stack Parameters	
English Units	
Stack Height (ft)	95
Velocity (ft/sec)	60
Diameter (ft)	2.34
Flowrate (acfs)	258
Exhaust temperature (deg. F)	350
Metric Units (calculated):	
Stack Height (m)	28.96
Velocity (m/sec)	18.29
Diameter (ft)	0.713
Flowrate (m^3/sec)	7.30
Exhaust temperature (deg. K)	449.8
Type of Terrain:	complex, rural
Plume Rise Values vs. Stack Parameter	7
Maximum Terrain Rise (m)	58.5
Terrain-adjusted Effective Stack Height	4
Tier I Feed Rate Limits (lbs/hr)	
Non-carcinogenic Metals	
Antimony	3.1E-02
Barium	5.2E+00
Lead	9.4E-03
Mercury	3.1E-02
Silver	3.1E-01
Thallium	3.1E-02
Carcinogenic Metals	
Arsenic	2.4E-04
Beryllium	4.4E-04
Cadmium	5.8E-03
Chromium	8.7E-05
Total Chlorine	2.6E-01
Expected Feed Rates (lbs/hr)	
Non-carcinogenic Metals	
Antimony	6.0E-03
Barium	1.2E-02
Lead	1.1E-02
Mercury	1.9E-03
Silver	4.5E+00
Thallium	NA
Carcinogenic Metals	
Arsenic	3.4E-02
Beryllium	NA
Cadmium	9.9E-04
Chromium	1.2E-02
Sum of the Ratios of Expected Feed Rate/ Tier I Feed Rate Limit for Carcinogenic Metals	277.8
Total Chlorine	1.1E+03
Maximum Feed Rates (lbs/hr)	
Non-carcinogenic Metals	
Antimony	9.2E-03
Barium	1.2E-02
Lead	2.1E-02
Mercury	2.8E-03
Silver	4.5E+00
Thallium	NA
Carcinogenic Metals	
Arsenic	8.3E-02
Beryllium	NA
Cadmium	2.1E-03
Chromium	1.6E-02
Sum of the Ratios of Maximum Feed Rate/ Tier I Feed Rate Limit for Carcinogenic Metals	526.4
Total Chlorine	1.7E+02

The expected and maximum feed rates were compared with the Tier I results. The sum of the ratios of the expected total carcinogenic metals (arsenic, beryllium, cadmium, and chromium) feed rates to the Tier I carcinogenic metals feed rates must not exceed 1.0, or Tier II emission rate limitations must be applied. The sum of the ratios exceeded 1.0 by 277.8. The maximum feed rates were also evaluated. The results are presented in Table 5A-12.

Tier II limits follow the same methodology as the Tier I limits, but use the emission rates of the proposed facility. The Tier II emission rates in grams per second are given for all listed metals in Table 5A-14 as well as the expected and maximum emission rates. The sum of the ratios also exceeded 1.0. Therefore, for the carcinogenic metals, the maximum emission rates were assumed to be limited to the values in calculated from the Tier II estimates. These values are extremely conservative estimates of upper bound emissions because they are not related to the actual Basin F waste. Rather the Tier II values are estimates of what EPA considers the maximum acceptable emissions from a risk perspective, without conducting refined dispersion modeling and risk assessment such as conducted in this study.

5A.5 SUMMARY OF EMISSIONS

Table 5A-15 is a compilation of all the emission estimates developed in this section as well as the organic emission estimate developed as explained in Appendix 5B. The emissions were converted to mass-per-unit time using the projected waste feed rate (10,325 lb/hr) and annual operating schedule (7,000 hours per year) for the RMA facility. These rates were used to determine the predicted ambient concentrations and deposition rates.

Table 5A-14

Stack Parameters and Tier II Expected and Maximum Emission Rates for Complex Terrain

Stack Parameters	
English Units	
Stack Height (ft)	95
Velocity (ft/sec)	60
Diameter (ft)	2.34
Flowrate (acfs)	258
Exhaust temperature (deg. F)	350
Metric Units (calculated):	
Stack Height (m)	28.96
Velocity (m/sec)	18.29
Diameter (ft)	0.713
Flowrate (m^3/sec)	7.30
Exhaust temperature (deg. K)	449.8
Type of Terrain:	complex, rural
Plume Rise Values vs. Stack Parameter	7
Maximum Terrain Rise (m)	58.5
Terrain-adjusted Effective Stack Height	4
Tier II Emission Rate Limits (g/s)	
Non-carcinogenic Metals	
Antimony	3.9E-03
Barium	6.6E-01
Lead	1.2E-03
Mercury	3.9E-03
Silver	3.9E-02
Thallium	3.9E-03
Carcinogenic Metals	
Arsenic	3.1E-05
Beryllium	5.5E-05
Cadmium	7.3E-05
Chromium	1.1E-05
Hydrogen Chloride	3.3E-02
Expected Emission Rates (g/s)	
Non-carcinogenic Metals	
Antimony	2.3E-05
Barium	3.2E-05
Lead	4.0E-05
Mercury	3.6E-05
Silver	3.4E-03
Thallium	3.3E-04
Carcinogenic Metals	
Arsenic	1.3E-04
Beryllium	1.3E-06
Cadmium	3.8E-06
Chromium	8.9E-06
Sum of the Ratios of Expected Emission Rate/ Tier II Emission Rate Limit for Carcinogenic Metals	5.06
Hydrogen Chloride	1.5E+01
Maximum Emission Rates (g/s)	
Non-carcinogenic Metals	
Antimony	4.9E-05
Barium	1.2E-05
Lead	7.8E-05
Mercury	5.4E-05
Silver	3.4E-03
Thallium	3.1E-04
Carcinogenic Metals	
Arsenic	3.1E-04
Beryllium	2.6E-06
Cadmium	7.8E-06
Chromium	1.2E-05
Sum of the Ratios of Maximum Emission Rate/ Tier II Emission Rate Limit for Carcinogenic Metals	11.31
Hydrogen Chloride	2.2E+01

Table 5A-15

Emission Rates for Rocky Mountain Arsenal Basin F Waste Submerged Quench Incinerator

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Dioxins/Furans						
U.S. EPA TEF	4.16E-09	1.19E-09	1.50E-10	6.63E-08	1.90E-08	2.39E-09
Metals						
Aluminum	1.80E-02	5.15E-03	6.49E-04	2.50E-02	7.14E-03	8.99E-04
Antimony	6.34E-04	1.81E-04	2.28E-05	1.08E-01	3.10E-02	3.90E-03
Arsenic	3.59E-03	1.03E-03	1.29E-04	8.67E-03	2.48E-03	3.12E-04
Barium	8.79E-04	2.51E-04	3.16E-05	1.83E+01	5.24E+00	6.60E-01
Beryllium	3.66E-05	1.05E-05	1.32E-06	1.53E-03	4.37E-04	5.50E-05
Boron	2.68E-02	7.65E-03	9.63E-04	3.63E-02	1.04E-02	1.31E-03
Cadmium	1.04E-04	2.98E-05	3.76E-06	2.03E-03	5.79E-04	7.30E-05
Calcium	1.54E-01	4.39E-02	5.53E-03	2.93E-01	8.36E-02	1.05E-02
Chromium	2.47E-04	7.05E-05	8.88E-06	3.32E-04	9.49E-05	1.20E-05
Cobalt	7.89E-04	2.25E-04	2.84E-05	8.13E-04	2.32E-04	2.93E-05
Copper	3.35E+00	9.59E-01	1.21E-01	6.35E+00	1.82E+00	2.29E-01
Iron	4.77E-02	1.36E-02	1.72E-03	8.13E-02	2.32E-02	2.93E-03
Lead	1.12E-03	3.21E-04	4.05E-05	3.33E-02	9.52E-03	1.20E-03
Lithium	1.10E-04	3.14E-05	3.96E-06	2.07E-04	5.92E-05	7.45E-06
Magnesium	1.43E-01	4.08E-02	5.14E-03	2.39E-01	6.81E-02	8.59E-03
Manganese	6.16E-03	1.76E-03	2.22E-04	6.93E-03	1.98E-03	2.50E-04
Mercury	9.93E-04	2.84E-04	3.57E-05	1.08E-01	3.10E-02	3.90E-03
Molybdenum	1.10E-02	3.15E-03	3.97E-04	1.14E-02	3.25E-03	4.09E-04
Nickel	2.86E-02	8.18E-03	1.03E-03	2.97E-02	8.49E-03	1.07E-03
Potassium	1.14E+00	3.25E-01	4.09E-02	2.54E+00	7.24E-01	9.13E-02
Selenium	9.20E+00	2.63E+00	3.31E-01	9.20E+00	2.63E+00	3.31E-01
Silicon	1.58E-01	4.52E-02	5.70E-03	1.89E-01	5.41E-02	6.81E-03
Silver	9.52E-02	2.72E-02	3.43E-03	1.08E+00	3.10E-01	3.90E-02
Sodium	1.17E+02	3.34E+01	4.21E+00	5.56E+02	1.59E+02	2.00E+01
Strontium	3.66E-05	1.05E-05	1.32E-06	5.66E-05	1.62E-05	2.04E-06
Thallium	9.25E-03	2.64E-03	3.33E-04	1.08E-01	3.10E-02	3.90E-03
Tin	8.09E-03	2.31E-03	2.91E-04	8.79E-03	2.51E-03	3.16E-04
Titanium	6.10E-05	1.74E-05	2.20E-06	1.07E-04	3.07E-05	3.87E-06
Vanadium	2.34E-03	6.68E-04	8.42E-05	2.62E-03	7.49E-04	9.44E-05
Yttrium	NA	NA	NA	2.14E-05	6.11E-06	7.70E-07
Zinc	1.63E-02	4.65E-03	5.86E-04	3.34E-02	9.54E-03	1.20E-03
Organics						
1,1-Dichloroethene	3.81E-11	1.09E-11	1.37E-12			
1,2-Dichloroethene	2.65E-11	7.57E-12	9.53E-13			
1,2-Dichloropropane	3.07E-12	8.77E-13	1.11E-13			
1,3-Dimethylbenzene	2.72E-08	7.77E-09	9.79E-10			
Acetone	1.07E-11	3.07E-12	3.87E-13			
Ammonia	3.26E-03	9.32E-04	1.17E-04			
Benzene	1.40E-07	3.99E-08	5.03E-09			
Bromomethane	1.36E-08	3.89E-09	4.90E-10			
Carbon Tetrachloride	4.34E-11	1.24E-11	1.56E-12			
Chlorobenzene	3.37E-08	9.62E-09	1.21E-09			
Chloroform	6.87E-12	1.96E-12	2.47E-13			
Ethylbenzene	4.08E-08	1.17E-08	1.47E-09			
Methanol	1.63E-07	4.65E-08	5.86E-09			
Methylene Chloride	1.36E-08	3.89E-09	4.90E-10			
Tetrachlorethene	5.43E-10	1.55E-10	1.95E-11			
Toluene	6.80E-08	1.94E-08	2.45E-09			
Trichloroethene	8.33E-11	2.38E-11	3.00E-12			
Xylene	2.72E-08	7.77E-09	9.79E-10			
4-Chlorophenylmethylsulfone	2.52E-11	7.21E-12	9.08E-13			
4-Chlorophenylmethylsulfoxide	9.40E-11	2.69E-11	3.38E-12			
4-Nitrophenol	5.76E-11	1.64E-11	2.07E-12			
Aldrin	6.91E-12	1.97E-12	2.49E-13			
Atrazine	1.54E-12	4.39E-13	5.53E-14			

Table 5A-15

(continued)

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Organics						
Hydrogen Cyanide	6.46E-08	1.85E-08	2.32E-09			
Dieldrin	1.42E-12	4.06E-13	5.11E-14			
Diisopropyl Methylphosphonate	2.49E-10	7.13E-11	8.98E-12			
Dimethyl Methylphosphonate	5.95E-09	1.70E-09	2.14E-10			
Dimethyldisulfide	6.91E-10	1.97E-10	2.49E-11			
Dimethylphosphate	1.63E-09	4.66E-10	5.87E-11			
Dithiane	2.49E-13	7.13E-14	8.98E-15			
Endrin	1.38E-12	3.95E-13	4.97E-14			
Hexachlorocyclopentadiene	1.28E-11	3.67E-12	4.63E-13			
Isodrin	3.64E-12	1.04E-12	1.31E-13			
Malathion	5.56E-12	1.59E-12	2.00E-13			
Parathion	7.68E-13	2.19E-13	2.76E-14			
Supona	2.30E-12	6.58E-13	8.29E-14			
Urea	9.98E-07	2.85E-07	3.59E-08			
Vapona	6.14E-12	1.75E-12	2.21E-13			
p,p-DDE	1.15E-08	3.29E-09	4.14E-10			
p,p-DDT	2.30E-12	6.58E-13	8.29E-14			
PICs with Specific Precursors						
Vinyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Methyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Styrene	1.36E-07	3.90E-08	4.91E-09			
Phenol	7.37E-07	2.11E-07	2.65E-08			
Benzaldehyde	1.42E-07	4.05E-08	5.10E-09			
Benzoic Acid	6.86E-08	1.96E-08	2.47E-09			
Acetonitrile	6.52E-10	1.86E-10	2.35E-11			
Acrylonitrile	6.52E-11	1.86E-11	2.35E-12			
Cyanogen	6.52E-12	1.86E-12	2.35E-13			
Hexachlorobenzene	4.64E-10	1.32E-10	1.67E-11			
Pentachlorobenzene	2.07E-10	5.93E-11	7.47E-12			
Tetrachlorobenzene	8.75E-11	2.50E-11	3.15E-12			
Trichlorobenzene	4.62E-11	1.32E-11	1.66E-12			
Dichlorobenzene	2.45E-11	6.99E-12	8.81E-13			
Biphenyl	6.82E-08	1.95E-08	2.45E-09			
4-Chlorobiphenyl	7.88E-08	2.25E-08	2.84E-09			
4,4-Chlorobiphenyl	1.03E-09	2.95E-10	3.72E-11			
Benzonitrile	6.52E-11	1.86E-11	2.35E-12			
Pyridine	6.52E-12	1.86E-12	2.35E-13			
Carbazole	1.30E-11	3.73E-12	4.70E-13			
Quinoline	3.26E-11	9.32E-12	1.17E-12			
PICs without Specific Precursors						
Benzofuran	2.72E-07	7.77E-08	9.79E-09			
Dibenzofuran	1.36E-08	3.88E-09	4.89E-10			
Acenaphthalene	6.80E-08	1.94E-08	2.45E-09			
Acenaphthene	6.80E-08	1.94E-08	2.45E-09			
Fluoranthene	4.08E-08	1.17E-08	1.47E-09			
Phenanthrene	2.72E-08	7.77E-09	9.79E-10			
Pyrene	1.36E-08	3.88E-09	4.89E-10			
Fluorene	1.36E-08	3.88E-09	4.89E-10			
Benzo(a)pyrene	1.36E-08	3.88E-09	4.89E-10			
Dibenzo(a)anthracene	1.36E-08	3.88E-09	4.89E-10			
Chrysene	1.36E-08	3.88E-09	4.89E-10			

Table 5A-15

(continued)

Category/ Pollutant	Base Case (a) (ton/yr)	Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)	Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Acid Gases & Other Compounds						
Particulate Matter	14.00 (c)	4.00	0.50	14.00	4.00	0.50
Carbon Monoxide	4.71	1.35	0.17	7.29 (e)	2.08	0.26
Hydrogen Chloride	4.73 (d)	1.35	0.17	14.00 (f)	4.00	0.50
Hydrogen Fluoride	0.17	0.049	0.006	0.32	0.092	0.012
Nitric Acid	3.85	1.10	0.14	3.85	1.10	0.14
Nitrogen Dioxide	32.13	9.18	1.16	143.22 (f)	40.92	5.16
Phosphate	3.44	0.98	0.12	15.04	4.30	0.54
Sulfuric Acid	10.40	2.97	0.37	17.34	4.96	0.62
Sulfur Dioxide	24.43 (d)	6.98	0.88	101.50 (f)	29.00	3.65

(a) These estimates are based upon the acceptable results during the test burn for dioxins/furans and the maximum of the acceptable test results or the maximum of the averages waste stream data for inorganics (including metals, acid gases and other compounds). The volatile and semi-volatile organic emissions are based upon Dellinger's analysis of the maximum of the averages wastestream data.

(b) For metals: based upon the maximum value of the test results from the test burn, the maximum of the maximum values from the wastestream data, and the EPA Guidance Tier II limits for complex terrain.
For dioxins/furans: based upon the 95% confidence interval from WESTON's hazardous waste incinerator emissions database.
For acid gases & other compounds: based upon the maximum value of the test results from the test burn and the maximum of the maximum values from the wastestream data.

(c) Based upon Colorado's emission limitation of 0.08 gr/dscf @ 12% CO_2.

(d) Based upon the February 1989 test burn, which tested for the specific compound.

(e) Based upon Federal emission limitation of 100 ppm.

(f) Based upon vendor performance guarentees.

APPENDIX 5A

CITED REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Guidance on Metals and HCl Controls from Hazardous Waste Incineration, Draft Final Report. August, 1989.

Siebert, P.C., D.R. Alston, J.F. Walsh, and K.H. Jones, "Effects on Control Equipment and Operating Parameters on Municipal Solid Waste (MSW) Incinerator Trace Emissions." Paper 88-98.3 presented at the 81st Annual APCA Meeting, Dallas, Texas, 24 June 1988.

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APPENDIX 5B

ESTIMATE OF ORGANIC MASS EMISSION RATES FROM INCINERATION OF BASIN F LIQUIDS

Estimate of Organic Mass Emission Rates from the Incineration of Basin F Liquids

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October 27, 1990

Based on the estimated feed composition furnished by Mr. Paul Siebert of Weston Inc., an estimate of the organic emissions from the controlled incineration of Basin F liquids has been prepared. The difficulties in making accurate predictions of mass emission rates of organic pollutants is well documented. However, by making some reasonable assumptions it is possible to prepare an estimate of the relative emission rates of organic compounds, both Principal Organic Hazardous Constituents (POHCS) and Products of Incomplete Combustion (PICs). These relative emission rates can then be converted to absolute emission rates by "normalizing" these estimated emissions to actual measurements on the incinerator for a few selected compounds. When these measurements are not available, one can alternatively use the current EPA emissions regulations as a calibration technique.

The relative emission estimate identifies the theoretically most stable POHC, assuming its DRE to be 99.99% (the worst allowable case), the relative emission rate of every other POHC and PIC in the estimate may be ratioed to the emission rate of the most stable POHC to give calibrated emission rates for all of the potential emissions. These calibrated emission rates can then be used in conjunction with conventional risk assessment techniques to estimate the health risks due to the stack emissions.

The following paragraphs summarize the general scientific approach used to develop the relative emission rate data for POHCs and PICs. This is a very complex subject and a detailed discussion of the estimate of the emission rate for each compound is beyond the scope of this report. However, a short discussion of the emissions estimation procedure for several compounds of special interest based on various criteria is included. Polychlorinated dibenzo-p-dioxin and furans are not included in the emissions estimate because of their predicted ultra-trace yields for the compounds listed in the Basin F liquids.

At the conclusion of the report, a brief discussion of the results of this emissions estimate versus emissions measurements from other full scale facilities is presented. Appendix 1 presents the final emissions estimation results. The key to the table displays the actual calculation procedure used to obtain the relative emission rate estimates and the final calibrated or normalized emissions estimate. Appendix 2 contains the estimated PIC yields for input into the emissions estimate in Appendix 1.

BACKGROUND

Calculations and experimental observations have shown that the emissions of undestroyed, residual POHCs are kinetically, not thermodynamically controlled. [1,2] The destruction efficiency (DE) of POHCs is dominated by the temperature, time, and reaction atmosphere experienced by the POHCs in the high temperature zones of incinerators. Thus determination of the exact time, temperature, and reaction atmosphere history of all the molecules in an incinerator is necessary to determine the actual DE of a POHC. This type of information is , of course, not currently available. However, less information is required to estimate the relative DE of potential POHCS.

Simple conceptual and more complex computer models suggest that the gas-phase residence time, temperature, and reaction atmosphere in the post-flame or thermal zones of incinerators control the relative emissions of most POHCs. [3-5] The basic reasoning behind this is that all molecules entering the flame zone of an incinerator are essentially destroyed and only the small fraction of the material escaping the flame zone may be emitted for the facility. Various flame zone "failure modes" exist which may cause residual POHCs to be emitted. Once in the post-flame zone, gas-phase thermal decomposition kinetics controls the rate of POHC destruction and formation and destruction of PICs.

Calculations using available kinetic data indicate that the emissions observed from full scale incinerators are several orders of magnitude higher than those calculated using oxidation kinetics and residence times and temperatures anywhere near the mean values in the post-flame zone of the incinerator. [6] This suggests that oxygen depleted pathways must be responsible for most POHC and PIC emissions since the rate of POHC destruction is significantly slowed and the rate of PIC formation is increased under pyrolysis.

Even though the facility may be operating under nominally excess air conditions, poor mixing will result in oxygen-deficient pockets where the rate of POHC destruction is low and PIC formation is favored. Consequently, it is believed that gas-phase thermal stability under sub-stoichiometric oxygen conditions may be an effective predictor of POHC relative incinerability.

A recent study compared the incinerability predictions of several proposed POHC ranking methods with results of 10 pilot or full-scale test burns. [6] The ranking methods include heat of combustion, autoignition temperature, ignition delay time, flame failure modes, theoretical flame

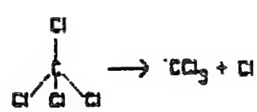
mode kinetics, thermal stability of pure compounds under excess air conditions, thermal stability of mixtures under oxidative conditions, and thermal stability of mixtures under oxygen-starved conditions. Correlations of the prediction of the rankings with field results were poor except for thermal stability of mixtures under oxygen-starved conditions. Although the laboratory data base used to predict full-scale POHC DREs were very limited, statistically significant correlations in 7 of 10 cases were observed using this ranking approach. The results of this comparison along with theoretical considerations suggest that pyrolysis kinetics may be used to develop relative mass emission rate estimates (i.e. ranking of incinerability). Experimental studies have recently been undertaken to obtain stability data for Appendix VIII compounds using this approach. [7]

POHC STABILITY

In most general terms, the decomposition of a molecule can be initiated by either radical attack (i.e., bimolecular pathway) or by an internal redistribution of energy such that the molecule decomposes or rearranges (i.e., unimolecular pathway).

Unimolecular reactions can be further subclassified into bond homolysis, which involves breaking of the weakest bond, and concerted elimination, which involves an internal rearrangement and elimination of a stable species such as HCl, H2O, or CO2. [8]

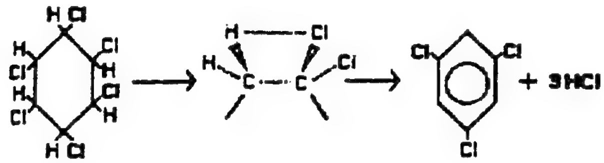
An example of bond homolysis is carbon-chlorine bond rupture in carbon tetrachloride by reaction 1.



(rxn. 1)

This reaction involves breaking of a relatively low energy bond of approximately 70 kcal/mole. Other Appendix VIII organics such as nitroglycerine, tetranitromethane, hydrazine, methyl hydrazine, 1,1,dimethylhydrazine are documented to proceed by bond homolysis. Many other compounds such as difluorodichloromethane, hexachloroethane, and benzenethiol are expected to decompose largely by bond homolysis.

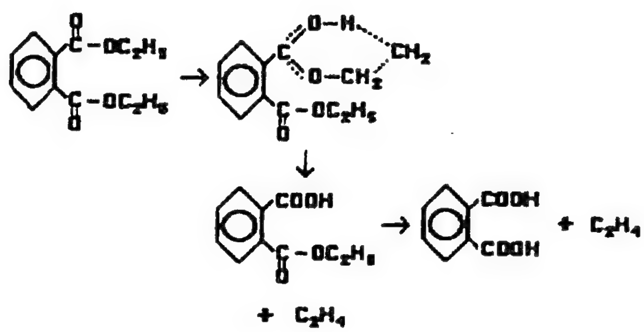
Concerted eliminations largely fall into two categories, four center processes and six-center processes. An interesting example of a four-center process is the decomposition of hexachlorocyclohexane depicted in reaction 2.



(rxn 2)

This pathway which results in ethylene and trichlorobenzene formation is expected to have a very low activation energy of about 55 kcal/mole. Practically any organic molecule with hydrogen and chlorine atoms on carbons connected by a single bond will undergo this type of process. Thus, species such as 1,1-dichloropropane, 2,2-dichloropropane; and 1,1,1-trichloroethane are known to undergo this process. Many other Appendix VIII organics are suspected of decomposing through this pathway.

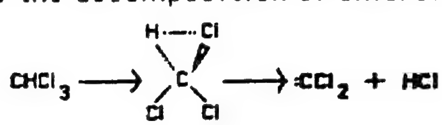
The best documented examples of molecules undergoing six -center concerted elimination are secondary esters. An example of this process is the decomposition of diethyl phthalate shown in reaction 3.



(rxn. 3)

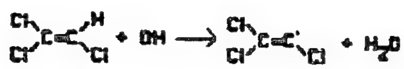
These reactions have activation energies on the order of 45-50 kcal/mole and are consequently very fast. Almost all of the phthalates listed in Appendix VIII can decompose by this mechanism and are consequently considered quite fragile. Other classes of molecules are isoelectronic with organic esters and are suspected of proceeding by similar pathways. These types of compounds include phosphoric acid esters, sulfonates, some amides, and thioesters.

Other compounds may undergo more rare three-center processes. The best documented example of a possible three-center decomposition of an Appendix VIII molecule is the decomposition of chloroform shown in reaction 4



(rxn. 4)

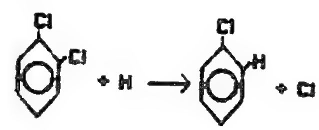
Bimolecular reaction pathways involving radical attack may be largely subdivided into three classes; atom metathesis, electrophilic addition, and displacement. An example of an Appendix VIII organic suspected of decomposing by simple hydrogen abstraction is trichloroethylene. (see rxn. 5)



(rxn. 5)

The radical initiating the abstraction may in principle be any number of species; but under oxidative conditions, the hydroxyl radical is suspected of being the dominant reactive radical. Hydrogen atoms and chlorine atoms are suspected of playing a larger role under pyrolytic conditions. Some possible pathways may be eliminated on thermodynamic grounds. Halogenated alkyls (that cannot undergo bond homolysis or concerted elimination) may decompose by this mechanism.

Displacement reactions largely involve the substitutions of one radical for another. An example would be the displacement of a chlorine atom by a hydrogen atom in o-dichlorobenzene (see rxn. 6).



(rxn. 6)

The rate of this reaction would increase with increasing chlorine substitution. In the case of chlorobenzenes, if displacement by hydrogen atoms dominates over addition or abstraction by hydroxyl radical, the relative incinerability rankings would be reversed from that predicted from a mechanism based on hydroxyl radical attack.

PIC FORMATION MECHANISMS

From a purely chemical reaction kinetic viewpoint, one may classify known mechanisms of PIC formation into three general groups: 1) concerted

molecular eliminations, 2) radical-molecule reactions, and 3) radical-atom or radical-radical recombination reactions. As illustrated in Table 1, these mechanisms occur in different regions of the incinerator and can result in PICs of different structure and stability. Consequently, the nature of PICs formed and their potential destruction will be dependent on the different exposure conditions. The reaction rates for PIC formation processes increase from zero- to second-order in the radical concentration as one proceeds from mechanism 1 to mechanism 3. Thus, stoichiometry and elemental composition of the waste/fuel feed may significantly impact PIC yields for radical-molecule and radical-radical reaction pathways.

TABLE 1

DESCRIPTION OF HAZARDOUS WASTE INCINERATOR PIC FORMATION ZONES AND DOMINANT PIC FORMATION MECHANISMS

ZONE	REACTION CONDITIONS	PIC MECHANISMS[a]
Preflame Zone	T = 200-1000°C	Mechanism 1[b]
	R.T. < 1 s	Mechanism 2[c]
	$[O_2]$ = 0-50% EA[e]	Mechanism 3[d]
Flame Zone	T = 1000-1800°C	Mechanism 2
	R.T. < 1 s	Mechanism 1
	$[O_2]$ = 50% EA[e]	Mechanism 3
Postflame Zone (afterburner)	T = 600-1100°C	Mechanism 2
	R.T. = 1-3 s	Mechanism 1
	$[O_2]$ = 50-100% EA[e]	Mechanism 3
Cool Zone (APCD and stack)	T = 80-600°C	Mechanism 3
	R.T. = 2-20 s	
	$[O_2]$ = 3-9%	

[a] PIC formation mechanisms listed in decreasing order of importance.
[b] Concerted molecular elimination reactions.
[c] Radical-molecule reactions.
[d] Radical-atom or radical-radical recombination reactions.
[e] Average values; localized deviations due to poor mixing can result in pyrolytic conditions.

Concerted molecular elimination to form stable PICs is a subclass of unimolecular reactions, viz., reactions only involving the parent compound. Since a second molecule or radical is not involved in the reaction, the PIC yield is dependent only upon time, temperature and the Arrhenius parameters of the molecular elimination reaction:

$$\%PIC\ YIELD = [PIC]/[POHC] \times 100 = 100[1-\exp\{-At\ \exp(-Ea/RT)\}] \quad \text{(Eqn. 1)}$$

where. [POHC] =concentration of the parent POHC; [PIC] = concentration of the PIC; t = reaction time; A = Arrhenius coefficient for the reaction; Ea = the activation energy for the reaction; T = the reaction temperature; and R = the universal gas constant.

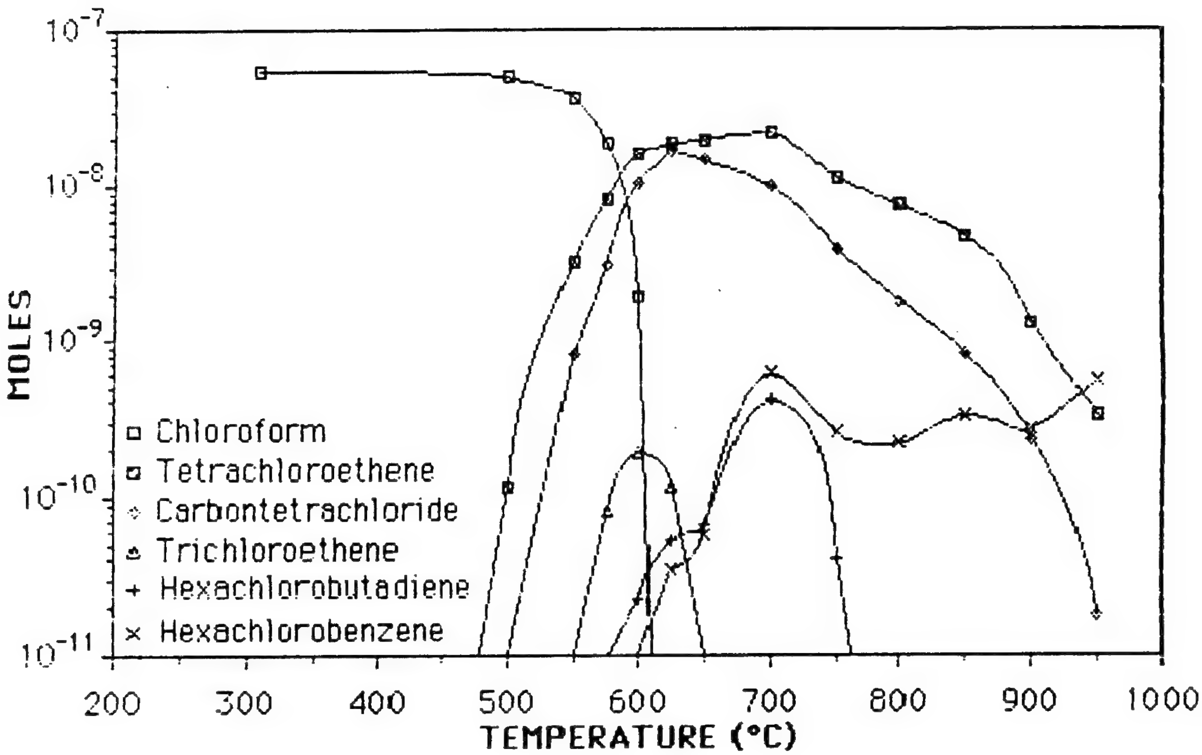
Kinetic parameters for many reactions of this type have been tabulated. [8] The reaction rates for these molecules are all energetically favorable under incineration conditions with an extent of reaction greater than 99% at temperatures below 700 C. Because these PIC formation pathways occur so rapidly, the resultant PIC can experience almost the full gas-phase residence time experienced by the parent POHC. Thus, PICs produced by molecular elimination may undergo decomposition resulting in secondary PIC formation, or the reaction may proceed to the formation of thermodynamically stable combustion products.

Examples of bimolecular reactions that result in stable PIC formation are radical-molecule reactions. Once the decomposition of the parent POHC is initiated and a pool of reactive radicals is formed, radical-molecule reactions will usually be the dominant pathway for PIC formation. Hydroxyl (OH) radicals are the dominant reactive species under stoichiometric and oxidative conditions, while H atoms are the dominant reactive species under pyrolytic conditions. In addition, polyatomic organic radicals are also believed to play an important role in the formation of PICs that are of higher molecular weight than the parent compound.

Figure 1 illustrates the formation of several of the major products from the decomposition of chloroform ($CHCl_3$) under 50% excess air conditions. Of particular interest is the formation hexachlorobenzene (C_6Cl_6) which is stable at high temperatures and is formed in percent yields. A mechanism has been proposed where $CHCl_3$ rapidly forms C_2HCl_5, which decomposes to produce C_2Cl_4 and trichloroethene (C_2HCl_3). [9] This is followed by a radical-molecule mechanism resulting in the formation of C_6Cl_6 from C_2HCl_3 through experimentally observed intermediates such as dichloroacetylene (C_2Cl_2) and 1,3-hexachlorobutadiene (C_4Cl_6).

It should be recognized that since the rate of PIC formation is dependent on the concentration of both the radical and molecule reaction

partners, the observed PIC yield will generally increase with increasing waste feed rate. It is also important to note that many reaction steps may be required for the formation of given PIC, e.g. C6Cl6. Thus, the high-temperature, gas-phase residence time may be very short for such PICs, and their DE be much less than expected based on the full residence time in the incinerator. This is in contrast to PICs formed by concerted molecular elimination and suggests that for identical PIC formation yields for these pathways, the radical-molecule route will result in greater PIC emission rates.



Recombination reactions of radicals or atoms to form stable molecules are expected to occur only when molecule concentrations are very low or radical concentrations are high. These reaction rates are second order with respect to radical concentration and are temperature independent or exhibit small negative temperature dependencies. Since radical concentrations in the combustion zone are at least a factor of 100 times less than stable molecule concentrations, it can be shown that the overall forward reaction rate for radical-molecule reactions are typically greater than 50 times the radical-radical reaction rates at temperatures in excess of 1200 C. At lower temperatures, e.g. 800 C, due to the higher activation energy for the radical-molecular reactions, the ratio of rates decreases to about 10. Since product distributions are exponentially dependent on the

reaction rate, radical-molecule reactions are clearly kinetically favored routes as compare to recombination reactions at temperature greater the 600 C.

Once in the cool zone, temperatures may be sufficiently low that radical-molecule reactions with stable combustion endproducts now present in high concentrations, e.g. CO_2, H_2O, and HCl, occur at a much slower rate. As a result, radical-radical recombination routes may now become kinetically significant. If the temperature is rapidly quenched downstream of the post-flame zone, the concentrations of these radicals may be predicted from equilibrium calculations at the temperature just upstream of the quenching boundary. With this information, the recombination product concentrations downstream of the quenching boundary can be generally related to the predicted radical concentrations. Once formed, these molecules are not subjected to high temperatures and may exit the incinerator undestroyed.

SPECIFIC EXAMPLES FOR THE BASIN F LIQUID

Several specific examples have been selected for more detailed discussion of their origin and fate for the Basin F liquid. These compounds were selected to be of interest due to 3 factors: toxicity, high predicted relative mass emission rate, and prevalence in emissions from other incinerators. A brief discussion of the organic mass emissions estimate follows.

Hexachlorobenzene - Once formed, hexachlorobenzene is expected to be a very stable compound due to its resistance to oxidative attack by hydroxyl radical. [4] It has also been shown to be formed from the thermal degradation of chloroform, carbon tetrachloride, and tetrachloroethene in laboratory studies [8,9] A simple mechanism for its formation from chloroform was delineated in the previous paragraphs of this report. The highly chlorinated pesticides Aldrin, Dieldrin, Endrin, hexachlorocyclopentadiene , and Isodrin are expected to form hexachlorobenzene in moderate yields from a primarily unimolecular mechanism.

Penta-, tetra-, tri-, and di-chlorinated benzenes - The chlorobenzenes are formed primarily through the same mechanisms as hexachlorobenzene. The hexachlorobenzene initially formed is successively dechlorinated by the favorable displacement of chlorine by hydrogen atoms. For trichlorobenzene and dichlorobenzene, additional routes for formation are available from molecular growth pathways from 1,1-dichloroethene and 1,2-dichloroethene.

Vinyl Chloride - Vinyl chloride is expected to be formed from a number of the waste feed components in relatively low yields. It is most

readily formed from 1,1-dichlorethene and 1,2-dichloroethene by chlorine displacement by hydrogen atoms.

Acetonitrile and Acrylonitrile - The stability of the nitrile radical is expected to be largely responsible for the formation of these compounds. The nitrile radical, which can be liberated by hydrogen abstraction from hydrogen cyanide, can readily recombine with methyl radicals or vinyl radicals in the cool zones of the incinerator to form acetonitrile and acrylonitrile, respectively.

Benzene - Benzene has been shown to be very stable under pyrolytic conditions. [7] Its estimated stability as a POHC was determined using actual laboratory data. Because of its kinetic and thermodynamic stability, it can be readily formed as a PIC from many sources. Its major route of formation in the waste is expected to be via a displacement reaction of vinyl, methyl, chloro and other substituent groups by hydrogen atoms from species such as styrene, toluene, xylene, chlorobenzene etc. In addition, a relatively large yield by unspecified pathways has been included for formation from the organic waste matrix. Mechanisms for its formation via molecular growth pathways which are generally analogous to that previously described for hexachlorobenzene can result in benzene formation from simple aliphatic and olefinic hydrocarbons. The yield used for this estimate is based on yields and mass emission rates found in full scale incineration studies. [1,10]

Chlorobenzene - The emission of chlorobenzene is predicted based on its stability as a POHC and potential for formation in relatively low yields from a number of components of this waste stream. The pesticides Supona, DDE, and DDT are expected to form chlorobenzene in high yields by simple displacement reactions of substuent groups by hydrogen atoms to directly form chlorobenzene. The only available mode for its destruction under oxygen starved conditions is chlorine displacement by hydrogen atoms which is very slow. The predicted stability is based on laboratory data.(7)

1,1-Dichloroethene - From laboratory studies, 1,1-dichloroethene is known to form from the thermal degradation of methylene chloride, tetrachloroethene, and trichloroethylene. It is also expected to be readily formed from Aldrin, Dieldrin, and Endrin. However, once formed it is not expected to be particularly stable. Its low pridected DE is primarily due to its very low feed rate in combination with a moderated PIC yield.

Bromomethane - All bonds in bromomethane are relatively strong and its is generally resistant to radical attack. Its emission is primarily due to its thermally refractive nature.

Tetrachloroethene - This compound has been previously observed in laboratory studies of the thermal degradation of carbon tetrachloride and chloroform in large yields. [9] In fact it is the major product from these compounds, and once formed it is expected to be very difficult to destroy.

Toluene - Toluene is a readily formed PIC from a variety of compounds. Its mechanism of formation is similar to that of benzene in that it is expected to proceed through fast molecular growth reactions. In addition, the benzyl radical is a very stable radical which might be expected to survive the combustion zones of the incinerator and form toluene in the cool zones by recombination with hydrogen atoms. Its primary mode of formation in this waste stream is expected to be very fast, favorable displacement reactions for 1,3-dimethylbenzene, chlorobenzene, ethylbenzene, and xylene. In these reactions hydrogen atoms would displace methy, chloro, ethyl, and vinyl substituents respectively.

Carbon Tetrachloride - Carbon tetrachloride is a relatively fragile POHC. Laboratory studies have shown that it is decomposed by greater than 99.99% DE at temperatures below 900 C. [7] Consequently, residual POHC emissions are not expected for this or any other moderately well operated incinerator. However, the trichloromethyl radical is a stable radical and can recombine with chlorine atoms in cool zones of the incinerator. For this waste stream, chloroform, methylene chloride, and tetrachloroethene are expected to be the major sources of carbon tetrachloride. Carbon tetrachloride has been demonstrated in laboratory studies to be formed in moderate yields from the thermal degradation of both chloroform and tetrachloroethene.

Acenapthalene, Acenaphthene, Fluoranthene, Phenanthrene, Pyrene, Fluorene, Benzo-[a]-pyrene, Dibenzo-[a]-Anthracene, and Chrysene - These nine polynuclear aromatic hydrocarbons (PNAs) have been commonly observed as emissions from full scale hazardous and municipal waste incinerators. [1] Their formation is through a mechanism similar to that described for benzene (and hexachlorobenzene) and generally involves addition of substituted vinyl radicals to olefinic substituents on already formed aromatics. These are complex mechanisms and it is difficult to predict their yields accurately. As a result yields and mass emission rate were based on full scale emission measurements and general principals of reaction kinetics. [1,7,10] The emission estimates for benzo-[a]-pyrene, dibenzo-[a]-anthracene, and chrysene are worst case estimates based on measured emission data of other PNAs, but are included because of their relatively high carcinogenicity.

EMISSION MEASUREMENTS AT FULL SCALE INCINERATORS

Full scale incinerator emissions measurements have resulted in measured PIC to POHC emission ratios of 1:1 to 3:1. Commonly observed PICs have been chloroform, carbon tetrachloride, bromoform, other brominated and chlorinated methanes, trichloroethane, trichloroethylene, and various phthalates, benzene, and toluene. [1] The emissions of such

compounds as chloroform, bromoform, 1,1,1-trichloroethane and diethyl phthalte appear puzzling at first because they are all known to be very fragile materials. However, the emissions of brominated compounds from incinerators which are not reported as burning brominated wastes is very suggestive of an alternative source of introduction of these pollutants.

In fact, it has been shown that many of these halogenated compounds are commonly found as contaminants in the scrubber inlet water. [1] Since they are very volatile, they can be volatilized by hot combustion gases and stripped into the flue gas. Trenholm has shown that in many cases the quantities of these compounds in the scrubber inlet water can account for all of the observed emissions. Phthalates are common plasticizers and can be easily introduced as sampling or analysis artifacts. They have been apparently anamolously observed air pollution studies. [10]

Since it appears that these compounds are not produced in the combustion system, they have not been included in the emissions estimate. Measurement or estimation of volatile halocarbons in the scrubber water must be made as a first step to estimating this potential source of emissions.

Footnotes to table - Estimate of Organic Emissions

B,C. Compounds and feed rate furnished by R.F. Weston

D. Based on actual laboratory generated experimental thermal decomposition data or extrapolated based on theory. DE (Thermal) is the destruction efficiency at 900 C achieved under laboratory non-flame conditions in a pyrolytic atmosphere

E. Based on the assumption that 99% of each POHC passes through the flame and is completely destroyed. The DE of the remaining 1% which is destroyed in the post-flame zone is assumed to be equal to DE (Thermal)
   Theoretical DE at 900C= 99.0000+0.01*DE(Thermal)

F. Emission Rate of POHC=Feed Rate*(1-Theoretical DE at 900C/100)

G. Emission Rate as PIC is based on the data included in the PIC estimate tables. The formation of each POHC as a PIC from every other POHC has been estimated. Also the contribution to PIC formation of poorly characterized reactions involving the waste feed as a whole have been included. Emission rates of other PICs have also been included at the bottom of the table.

H. Emission Rate as POHC and PIC= Emission Rate POHC+Emission Rate PIC

I. Effective Theoretical DE of POHC=100*(1-Emission Rate as POHC and PIC/Feed Rate)

J. Assumes that the incinerator achieves 99.99% DRE for the POHC which is most difficult to destroy. Toluene had the lowest Effective Theoretical DE of 47.8756% due to its very low feed rate and large propensity for PIC formation from a variety of compounds.
   Normalized Emission Rate=Emission as POHC and PIC*(0.0001/0.521244)

K. Normalized DE=100*(1-Normalized Emission Rate as POHC and PIC/Feed Rate)

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Appendix 1

Estimate of Organic POHC and PIC Mass Emission Rates from the Incineration of Basin F Liquids

	#	Compound	Fee[illegible]te (tons/yr)	DE (Thermal)	Theoretical DE at 900 C (%)	Emission Rate of POHC (tons/yr)
				D	E	
3						
4	1	1,1-Dichloroethene	6.5E-03	99.99	99.9999	6.500E-09
5	2	1,2-Dichloroethene	3.0E-07	99.99	99.9999	3.000E-13
6	3	1,2-Dichloropropane	1.6E-02	99.99	99.9999	1.600E-08
7	4	1,3-Dimethylbenzene	1.3E-03	99.99	99.9999	1.300E-09
8	5	Acetone	5.6E-02	99.99	99.9999	5.600E-08
9	6	Ammonia	1.7E+03	.00	99.0000	1.700E+01
10	7	Benzene	3.8E-03	51.00	99.5100	1.862E-05
11	8	Bromomethane	2.6E-04	97.00	99.9700	7.800E-08
12	9	Carbon Tetrachloride	4.3E-03	99.99	99.9999	4.300E-09
13	10	Chlorobenzene	1.2E-03	90.00	99.9000	1.200E-06
14	11	Chloroform	7.5E-03	99.99	99.9999	7.500E-09
15	12	Ethylbenzene	2.4E-03	99.99	99.9999	2.400E-09
16	13	Methanol	1.4E+02	99.99	99.9999	1.400E-04
17	14	Methylene Chloride	7.3E-03	99.99	99.9999	7.300E-09
18	15	Tetrachloroethene	3.9E-03	99.90	99.9990	3.900E-08
19	16	Toluene	6.8E-04	99.32	99.9932	4.624E-08
20	17	Trichloroethene	1.3E-02	99.95	99.9995	6.500E-08
21	18	Xylene	7.6E-03	99.95	99.9995	3.800E-08
22	19	4-Chlorophenylmethylsulfone	3.9E-03	99.99	99.9999	3.900E-09
23	20	4-Chlorophenylmethylsulfoxide	4.9E-01	99.99	99.9999	4.900E-07
24	21	4-Nitrophenol	3.0E-01	99.99	99.9999	3.000E-07
25	22	Aldrin	3.6E-02	99.99	99.9999	3.600E-08
26	23	Atrazine	8.0E-03	99.99	99.9999	8.000E-09
27	24	Hydrogen Cyanide	3.4E-02	1.00	99.0100	3.366E-04
28	25	Dieldrin	7.4E-03	99.99	99.9999	7.400E-09
29	26	Diisopropyl Methylphosphonate	1.3E+00	99.99	99.9999	1.300E-06
30	27	Dimethyl Methylphosphonate	3.1E+01	99.99	99.9999	3.100E-05
31	28	Dimethyldisulfide	3.6E+00	99.99	99.9999	3.600E-06
32	29	Dimethylphosphate	8.5E+00	99.99	99.9999	8.500E-06
33	30	Dithiane	1.3E-03	99.99	99.9999	1.300E-09
34	31	Endrin	7.2E-03	99.99	99.9999	7.200E-09
35	32	Hexachlorocyclopentadiene	6.7E-02	99.99	99.9999	6.700E-08
36	33	Isodrin	1.9E-02	99.99	99.9999	1.900E-08
37	34	Malathion	2.9E-02	99.99	99.9999	2.900E-08
38	35	Parathion	4.0E-03	99.99	99.9999	4.000E-09
39	36	Supona	1.2E-02	99.99	99.9999	1.200E-08
40	37	Urea	5.2E+03	99.99	99.9999	5.200E-03
41	38	Vapona	3.2E-02	99.99	99.9999	3.200E-08
42	39	p,p-DDE	3.9E-03	99.99	99.9999	3.900E-09
43	40	p,p-DDT	1.2E-02	99.99	99.9999	1.200E-08

	A	B	C	D	E	F
44						
45		**PICS With Specific Precursors**				
46		Vinyl Chloride				
47		Methyl Chloride				
48		Styrene				
49		Phenol				
50		Benzaldehyde				
51		Benzoic Acid				
52		Acetonitrile				
53		Acrylonitrile				
54		Cyanogen				
55		Hexachlorobenzene				
56		Pentachlorobenzene				
57		Tetrachlorobenzene				
58		Trichlorobenzene				
59		Dichlorobenzene				
60		Biphenyl				
61		4-Chlorobiphenyl				
62		4,4'-Chlorobiphenyl				
63		Benzonitrile				
64		Pyridine				
65		Carbazole				
66		Quinoline				
67						
68		**PICS WITHOUT SPECIFIC PRECURSORS**				
69		Benzofuran				
70		Dibenzofuran				
71		Acenaphthalene				
72		Acenaphthene				
73		Fluoranthene				
74		Phenanthrene				
75		Pyrene				
76		Fluorene				
77		Benzo-[a]-pyrene				
78		Dibenzo-[a]-anthracene				
79		Chrysene				

	G	H	I	J	K
1	Emission Rate	Emission Rate as	Effective Theoretical	Normalized Emission	Normalized DE
2	as PIC (tons/yr)	POHC and PIC (tons/yr)	DE at 900C (%)	Rate (tons /yr)	(%)
3					
4	1.922E-07	1.987E-07	99.9969	3.812E-11	100.0000
5	1.380E-07	1.380E-07	53.9999	2.648E-11	99.9912
6	0.000E+00	1.600E-08	99.9999	3.070E-12	100.0000
7	1.417E-04	1.417E-04	89.0989	2.719E-08	99.9979
8	0.000E+00	5.600E-03	99.9999	1.074E-11	100.0000
9	0.000E+00	1.700E+01	99.0000	3.262E-03	99.9993
10	7.101E-04	7.288E-04	80.8219	1.398E-07	99.9963
11	7.086E-05	7.093E-05	72.7177	1.361E-08	99.9948
12	2.218E-07	2.261E-07	99.9947	4.338E-11	100.0000
13	1.743E-04	1.755E-04	85.3750	3.367E-08	99.9972
14	2.830E-08	3.580E-08	99.9995	6.869E-12	100.0000
15	2.126E-04	2.126E-04	91.1416	4.079E-08	99.9983
16	7.086E-04	8.486E-04	99.9994	1.628E-07	100.0000
17	7.092E-05	7.092E-05	99.0284	1.361E-08	99.9998
18	2.790E-06	2.829E-06	99.9275	5.428E-10	100.0000
19	3.544E-04	3.544E-04	47.8756	6.801E-08	99.9900
20	3.691E-07	4.341E-07	99.9967	8.329E-11	100.0000
21	1.417E-04	1.418E-04	98.1349	2.720E-08	99.9996
22	1.276E-07	1.315E-07	99.9966	2.523E-11	100.0000
23	0.000E+00	4.900E-07	99.9999	9.401E-11	100.0000
24	0.000E+00	3.000E-07	99.9999	5.756E-11	100.0000
25	0.000E+00	3.600E-08	99.9999	6.907E-12	100.0000
26	0.000E+00	8.000E-09	99.9999	1.535E-12	100.0000
27	0.000E+00	3.366E-04	99.0100	6.458E-08	99.9993
28	0.000E+00	7.400E-09	99.9999	1.420E-12	100.0000
29	0.000E+00	1.300E-06	99.9999	2.494E-10	100.0000
30	0.000E+00	3.100E-05	99.9999	5.948E-09	100.0000
31	0.000E+00	3.600E-06	99.9999	6.907E-10	100.0000
32	0.000E+00	8.500E-06	99.9999	1.631E-09	100.0000
33	0.000E+00	1.300E-09	99.9999	2.494E-13	100.0000
34	0.000E+00	7.200E-09	99.9999	1.381E-12	100.0000
35	0.000E+00	6.700E-08	99.9999	1.285E-11	100.0000
36	0.000E+00	1.900E-08	99.9999	3.645E-12	100.0000
37	0.000E+00	2.900E-08	99.9999	5.564E-12	100.0000
38	0.000E+00	4.000E-09	99.9999	7.675E-13	100.0000
39	0.000E+00	1.200E-08	99.9999	2.302E-12	100.0000
40	0.000E+00	5.200E-03	99.9999	9.977E-07	100.0000
41	0.000E+00	3.200E-08	99.9999	6.140E-12	100.0000
42	6.000E-05	6.000E-05	98.4614	1.151E-08	99.9997
43	0.000E+00	1.200E-08	99.9999	2.302E-12	100.0000

	G	H	I	J	K
44					
45					
46	7.095E-04	7.095E-04		1.361E-07	
47	7.086E-04	7.086E-04		1.360E-07	
48	7.111E-04	7.111E-04		1.364E-07	
49	3.843E-03	3.843E-03		7.373E-07	
50	7.386E-04	7.386E-04		1.417E-07	
51	3.573E-04	3.573E-04		6.855E-08	
52	3.400E-06	3.400E-06		6.523E-10	
53	3.400E-07	3.400E-07		6.523E-11	
54	3.400E-08	3.400E-08		6.523E-12	
55	2.417E-06	2.417E-06		4.637E-10	
56	1.081E-06	1.081E-06		2.074E-10	
57	4.560E-07	4.560E-07		8.749E-11	
58	2.410E-07	2.410E-07		4.624E-11	
59	1.276E-07	1.276E-07		2.448E-11	
60	3.553E-04	3.553E-04		6.817E-08	
61	4.107E-04	4.107E-04		7.880E-08	
62	5.382E-06	5.382E-06		1.033E-09	
63	3.400E-07	3.400E-07		6.523E-11	
64	3.400E-08	3.400E-08		6.523E-12	
65	6.800E-08	6.800E-08		1.305E-11	
66	1.700E-07	1.700E-07		3.262E-11	
67					
68					
69	1.417E-03	1.417E-03		2.719E-07	
70	7.086E-05	7.086E-05		1.359E-08	
71	3.543E-04	3.543E-04		6.797E-08	
72	3.543E-04	3.543E-04		6.797E-08	
73	2.126E-04	2.126E-04		4.078E-08	
74	1.417E-04	1.417E-04		2.719E-08	
75	7.086E-05	7.086E-05		1.359E-08	
76	7.086E-05	7.086E-05		1.359E-08	
77	7.086E-05	7.086E-05		1.359E-08	
78	7.086E-05	7.086E-05		1.359E-08	
79	7.086E-05	7.086E-05		1.359E-08	

Footnotes to table - Estimate of Organic Emissions

B,C. Compounds and feed rate furnished by R.F. Weston

D. Based on actual laboratory generated experimental thermal decomposition data or extrapolated based on theory. DE (Thermal) is the destruction efficiency at 900 C achieved under laboratory non-flame conditions in a pyrolytic atmosphere

E. Based on the assumption that 99% of each POHC passes through the flame and is completely destroyed. The DE of the remaining 1% which is destroyed in the post-flame zone is assumed to be equal to DE (Thermal)
Theoretical DE at 900C= 99.0000+0.01*DE(Thermal)

F. Emission Rate of POHC=Feed Rate*(1-Theoretical DE at 900C/100)

G. Emission Rate as PIC is based on the data included in the PIC estimate tables. The formation of each POHC as a PIC from every other POHC has been estimated. Also the contribution to PIC formation of poorly characterized reactions involving the waste feed as a whole have been included. Emission rates of other PICs have also been included at the bottom of the table.

H. Emission Rate as POHC and PIC= Emission Rate POHC+Emission Rate PIC

I. Effective Theoretical DE of POHC=100*(1-Emission Rate as POHC and PIC/Feed Rate)

J. Assumes that the incinerator achieves 99.99% DRE for the POHC which is most difficult to destroy. Toluene had the lowest Effective Theoretical DE of 47.8756% due to its very low feed rate and large propensity for PIC formation from a variety of compounds.
Normalized Emission Rate=Emission as POHC and PIC*(0.0001/0.521244)

K. Normalized DE=100*(1-Normalized Emission Rate as POHC and PIC/Feed Rate)

Appendix 2

Estimate of PIC Yields for the Incineration of Basin F Liquids

	A	B	C	D	E	F	G
1			Feed Rate			PIC Yield (%)	
2	#	Parent POHC	(tons/yr)				
3				1,1-Dichloroe	1,2-Dichloroe	1,2-Dichlorop	1,3-Dimethyl
4	1	1,1-Dichloroethene	6.5E-03				
5	2	1,2-Dichloroethene	3.0E-07				
6	3	1,2-Dichloropropane	1.6E-02				
7	4	1,3-Dimethylbenzene	1.3E-03				
8	5	Acetone	5.6E-02				
9	6	Ammonia	1.7E+03				
10	7	Benzene	3.8E-03				
11	8	Bromomethane	2.6E-04				
12	9	Carbon Tetrachloride	4.3E-03				
13	10	Chlorobenzene	1.2E-03				
14	11	Chloroform	7.5E-03	2.0E-04			
15	12	Ethylbenzene	2.4E-03				
16	13	Methanol	1.4E+02				
17	14	Methylene Chloride	7.3E-03	1.0E-04	2.0E-04		
18	15	Tetrachloroethene	3.9E-03	1.0E-04	2.0E-04		
19	16	Toluene	6.8E-04				1.0E-04
20	17	Trichloroethene	1.3E-02	1.0E-03	5.0E-04		
21	18	Xylene	7.6E-03				
22	19	4-Chlorophenylmethylsulfone	3.9E-03				
23	20	4-Chlorophenylmethylsulfoxide	4.9E-01				
24	21	4-Nitrophenol	3.0E-01				
25	22	Aldrin	3.6E-02	1.0E-04	1.0E-04		
26	23	Atrazine	8.0E-03				
27	24	Hydrogen Cyanide	3.4E-02				
28	25	Dieldrin	7.4E-03		1.0E-04		
29	26	Diisopropyl Methylphosphonate	1.3E+00				
30	27	Dimethyl Methylphosphonate	3.1E+01				
31	28	Dimethyldisulfide	3.6E+00				
32	29	Dimethylphosphate	8.5E+00				
33	30	Dithiane	1.3E-03				
34	31	Endrin	7.2E-03		1.0E-04		
35	32	Hexachlorocyclopentadiene	6.7E-02				
36	33	Isodrin	1.9E-02				
37	34	Malathion	2.9E-02				
38	35	Parathion	4.0E-03				
39	36	Supona	1.2E-02				
40	37	Urea	5.2E+03				
41	38	Vapona	3.2E-02				
42	39	p,p-DDE	3.9E-03				
43	40	p,p-DDT	1.2E-02				
44							
45		Total Organic Feed Rate=	7.1E+03				2.000E-06
46							
47		**Total PIC Emission Rate (t/yr)=**		1.922E-07	1.380E-07	0.000E+00	1.417E-04

	H	I	J	K	L	M	N	O
1				PIC Yield (%)				
2								
3	Acetone	Ammonia	Benzene	Bromomethane	Carbon Tetrach	Chlorobenzene	Chloroform	Ethylbenzen
4						1.0E-04		
5						1.0E-04		
6								
7			5.0E-04			1.0E-04		
8								
9								
10						2.0E-04		
11								
12							1.0E-04	
13			1.0E-03					
14					1.0E-03			
15			1.0E-03			5.0E-04		
16								
17					1.0E-04			
18					5.0E-04			
19			1.0E-03			5.0E-04		1.0E-04
20								
21			5.0E-04			1.0E-04		
22						5.0E-03		
23						5.0E-03		
24			5.0E-04			1.0E-04		
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39						5.0E-02		
40								
41								
42						1.0E-02		
43					1.0E-03	1.0E-02	2.0E-04	
44								
45			1.000E-05	1.000E-06		2.000E-06		3.000E-06
46								
47	0.000E+00	0.000E+00	7.101E-04	7.086E-05	2.218E-07	1.743E-04	2.830E-08	2.126E-04

	P	Q	R	S	T	U	V	W
1				PIC Yield (%)				
2								
[illegible]	Methanol	Methylene Chlc	Tetrachloroeth	Toluene	Trichloroethen	Xylene	1,4-Dichlorob	4-Chloropheny
4		1.0E-04					3.0E-04	
5							3.0E-04	
6								
7				1.0E-03				
8								
9								
10								
11								
12			3.0E-02		3.0E-03		2.0E-04	
13				1.0E-04				
14		5.0E-04	2.0E-02		2.0E-03		2.0E-04	
15				1.0E-03				
16								
17					7.0E-04			
18		1.0E-04			1.0E-03		5.0E-04	
19						1.0E-04		
20		1.0E-04					5.0E-04	
21				1.0E-03				
22								
23								
24								
25								
26								
[illegible]								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45	1.000E-05	1.000E-06		5.000E-06		2.000E-06		
46								
47	7.086E-04	7.092E-05	2.790E-06	3.544E-04	3.691E-07	1.417E-04	1.276E-07	0.000E+00

	X	Y	Z	AA	AB	AC	AD	AE
1				PIC Yield (%)				
2								
3	4-Chloropheno	4-Nitrophenol	Aldrin	Atrazine	Hydrogen Cyan	Dieldrin	Diisopropyl Me	Dimethyldis
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

	AF	AG	AH	AI	AJ	AK	AL	AM
1				PIC Yield (%)				
2								
3	Dimethylphosp	Dithiane	Endrin	Hexachlorocyc	Isodrin	Malathion	Parathion	Supona
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

	AN	AO	AP	AQ	AR	AS	AT	AU
1				PIC Yield (%)				
2								
3	Urea	Yapona	p,p-DDE	p,p-DDT				
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43			5.0E-01					
44								
45								
46								
47	0.000E+00	0.000E+00	6.000E-05	0.000E+00				

	AV	AW	AX	AY	AZ	BA	BB	BC
1			YIELD OF PICS WITH SPECIFIC PRECURSORS (%)					
2								
3	Vinyl Chloride	Methyl Chlorid	Styrene	Phenol	Benzaldehyde	Benzoic Acid	Acetonitrile	Acrylonitrile
4	1.0E-03							
5	1.0E-03							
6								
7								
8								
9								
10				1.0E-03	1.0E-04			
11								
12								
13			1.0E-04	3.0E-04				
14								
15			1.0E-01	5.0E-04	1.0E-04			
16								
17		1.0E-03						
18	1.0E-04							
19				5.0E-04	1.0E-04			
20	2.0E-03							
21								
22	1.0E-04							
23	1.0E-04							
24				1.0E-01	1.0E-02	1.0E-03		
25								
26								
27							1.0E-02	1.0E-03
28								
29								
30								
31								
32								
33								
34								
35	1.0E-04							
36	1.0E-04							
37								
38								
39								
40								
41			5.0E-04					
42	1.0E-04		2.0E-04					
43								
44								
45	1.0E-05	1.0E-05	1.0E-05	5.0E-05	1.0E-05	5.0E-06		
46								
47	7.095E-04	7.086E-04	7.111E-04	3.843E-03	7.386E-04	3.573E-04	3.400E-06	3.400E-07

	BD	BE	BF	BG	BH	BI	BJ	BK
1			YIELD OF PICS WITH SPECIFIC PRECURSORS (%)					
2								
3	Cyanogen	Hexachloroben	Pentachlorober	Tetrachlorober	Trichlorobenze	Dichlorobenzer	Biphenyl	4-Chlorobip
4					2.0E-04	3.0E-04		
5					2.0E-04	3.0E-04		
6								
7								
8								
9								
10							1.0E-02	1.0E-03
11								
12		5.0E-03	2.0E-03	1.0E-03	5.0E-04	2.0E-04		
13							1.0E-03	5.0E-03
14		5.0E-03	2.0E-03	1.0E-03	5.0E-04	2.0E-04		
15							2.0E-03	2.0E-04
16								
17								
18		1.0E-02	5.0E-03	2.0E-03	1.0E-03	5.0E-04		
19							1.0E-03	1.0E-04
20		1.0E-02	5.0E-03	2.0E-03	1.0E-03	5.0E-04		
21								
22							1.0E-04	5.0E-02
23							1.0E-04	5.0E-02
24								
25		1.0E-04						
26								
27	1.0E-04							
28		1.0E-04						
29								
30								
31								
32								
33								
34		1.0E-04						
35		1.0E-04						
36		1.0E-04						
37								
38							1.0E-04	
39							1.0E-04	5.0E-02
40								
41								
42							1.0E-04	1.0E-01
43							1.0E-04	1.0E-01
44								
45							5.0E-06	2.0E-06
46								
47	3.400E-08	2.417E-06	1.081E-06	4.560E-07	2.410E-07	1.276E-07	3.553E-04	4.107E-04

	BL	BM	BN	BO	BP	BQ	BR	BS
1			YIELD OF PICS WITH SPECIFIC PRECURSORS (%)					
2								
3	4,4'-Chlorobi	Benzonitrile	Pyridine	Carbazole	Quinoline			
4								
5								
6								
7								
8								
9								
10	1.0E-04							
11								
12								
13	1.0E-04							
14								
15								
16								
17								
18								
19								
20								
21								
22	1.0E-03							
23	1.0E-03							
24								
25								
26								
27		1.0E-03	1.0E-04	2.0E-04	5.0E-04			
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39	1.0E-03							
40								
41								
42	2.0E-03							
43	2.0E-03							
44								
45								
46								
47	5.382E-06	3.400E-07	3.400E-08	6.800E-08	1.700E-07			

	BT	BU	BV	BW	BX	BY	BZ	CA
1			YIELD OF PICS WITHOUT SPECIFIC PRECURSORS(%)					
2								
3	Benzofuran	Dibenzofuran	Acenaphthalene	Acenaphthene	Fluoranthene	Phenanthrene	Pyrene	Fluorene
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
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30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45	2.0E-05	1.0E-06	5.0E-06	5.0E-06	3.0E-06	2.0E-06	1.0E-06	1.0E-06
46								
47	1.417E-03	7.086E-05	3.543E-04	3.543E-04	2.126E-04	1.417E-04	7.086E-05	7.086E-05

	CB	CC	CD	CE	CF
1	YIELD OF PICS WITHOUT SPECIFIC PRECURSORS(%)				
2					
3	Benzo-[a]-pyr	Dibenzo-[a]-a	Chrysene		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45	1.0E-06	1.0E-06	1.0E-06		
46					
47	7.086E-05	7.086E-05	7.086E-05		

APPENDIX 6A

AMBIENT AIR QUALITY MODELING AND HEALTH RISK ASSESSMENT PROTOCOLS

ROCKY MOUNTAIN ARSENAL
BASIN "F" LIQUID INCINERATION SYSTEM DESIGN

DRAFT

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Preplanned Remedial Action Contract (PRAC)
Contract No. DACA45-90-D-0015

Task Order No. 1
Document Control No. 3886-44-01-AATT

REVISED DRAFT

AMBIENT AIR QUALITY MODELING AND HEALTH RISK ASSESSMENT PROTOCOLS

FOR

ROCKY MOUNTAIN ARSENAL BASIN "F" LIQUID INCINERATION SYSTEM DESIGN

Commerce City, CO

Revised 25 November 1990

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SECTION 1
INTRODUCTION

The following protocols describe the ambient air quality modeling and health risk assessment approach that will be used to establish numeric emission limits for the Submerged Quench Incinerator (SQI) at the Rocky Mountain Arsenal (RMA) in Denver, Co. RMA is required to install and operate the SQI to destroy the Basin F liquids currently stored in the (3) three tanks and a double lined pond at the Arsenal. The action is part of the Interim Remedial Action (IRA) selected to treat and dispose of the Basin F liquid. These protocols describe the method to be used to establish stack gas emission limits for the incinerator which correspond to the allowable risk level/hazard index (as identified in the decision document) for the nearest exposed population. The protocols are based on U.S. EPA guidelines on air quality modeling and risk assessments and WESTON's experience gained through similar work assignments. The remaining portion of Section 1 presents a brief facility and process description. Section 2 provides a description of the air quality models, input data, and modeling approach to be used and Section 3 provides a description of the health risk assessment approach and methodology for contaminant identification, toxicity assessment, and exposure assessment.

1.1 FACILITY LOCATION AND PROCESS DESCRIPTION

1.1.1 Facility Description

The following facility description is a summary of the information provided in the Final Decision Document for the Basin F Liquid Interim Remedial Action (IRA). Rocky Mountain Arsenal (RMA) occupies over 17,000 acres (approximately 27 square miles) in Adams County, directly northeast of metropolitan Denver, Colorado. RMA was established in 1942 and has been the site of manufacture of chemical incendiary munitions and chemical munitions demilitarization. Agricultural chemicals including pesticides were manufactured at RMA from 1947 to 1982.

In 1956, an evaporation pond called Basin F was constructed in the northern part of RMA. Basin F had a surface area of 92.7 acres and a capacity of approximately 243 million gallons. From August 1957 until its use was discontinued in December 1981, Basin F was the only evaporative disposal facility in service at RMA.

In 1986, the Department of the Army, Shell Oil Company, and the U.S. Environmental Protection Agency (EPA) Region VIII, agreed that an accelerated remediation be undertaken pursuant to CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) to contain the liquid and contaminated soils in and under Basin F. In a June 5, 1987 report to the court, the Organizations and the State agreed that fourteen interim actions, including the Basin FIRA, were necessary to expedite the cleanup of RMA.

In the first part of Basin F remediation, Basin F liquid was transferred to three lined steel storage tanks and to one double-lined covered pond. Transfer of Basin F liquid to tanks and Pond A for interim storage was initiated in May, 1988 and completed in December 1988. Presently approximately 4 million gallons of liquid are stored in the tank farm and 4.5 million gallons are stored in Pond A.

The Army has selected submerged quench incineration (SQI) to thermally treat 8.5 million gallons of stored liquid from Basin F at Rocky Mountain Arsenal as an Interim Remedial Action. The SQI consists of a feed system to inject the Basin F liquid into the incinerator; the high temperature incinerator with a quench chamber to cool the gases and dissolve the molten salts from combustion; a spray dryer; and associated air pollution control equipment.

1.1.2 Process Description

The submerged quench incineration process will use a vertical downfired liquid incinerator. The liquid to be incinerated would be injected at the top of the furnace into a gas flame. Burning the liquid at high temperature (about 1,900°F) is expected to destroy the organic compounds in Basin F liquid. After incineration, all the combustion products will be forced

downward and cooled in a liquid quench tank, to aid in washing out particulates and cleaning the exhaust gases. The high temperatures will melt noncombustible components of the Basin F liquid, producing molten salts which will flow down the walls of the incinerator and also be cooled in a quench chamber. The exhaust gases, which will include a mixture of combustion byproducts and other gases, will be passed through air pollution control devices which include a venturi scrubber and a packed tower. The brine from this process may be disposed of offsite as a liquid.

Operation of the submerged quench incineration process will require the transportation onto the Arsenal of 2,600 cubic yards per year of sodium hydroxide, a caustic compound used in the air pollution control process. The submerged quench incineration process will produce salts, of about 25 percent of the original volume of the Basin F liquid. These salts which contain metals will be disposed of in an off-site hazardous waste landfill.

1.2 PHYSICAL EMISSION CHARACTERISTICS

The physical emission characteristics of the submerged quench incinerator have not been finalized at this time. The incinerator will be designed and operated to meet the RCRA incinerator requirements which are presented in Table 1-1. The trial burn will be required to demonstrate the ability of the incinerator to achieve the performance requirements outlined in the Final Decision Document(May, 1990).

1.3 GOOD ENGINEERING PRACTICE ANALYSIS

Section 123 of the Clean Air Act defines Good Engineering Practice (GEP), with respect to stack heights, as "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source

Table 1-1

RCRA Incinerator Requirements[a]

Destruction and Removal Efficiencies	
Dioxin and Dibenzofurans	99.9999%
Polychlorinated Biphenyls	99.9999%
All other Organic Compounds	99.99%
Particulates Emissions	0.08 grains per dry standard cubic ft. @ 7% O_2
Hydrogen Chloride Emissions	1.8 kg/hour 4.0 lb/hour

[a] 40 CFR 264.343 (Performance Standards)

itself, nearby structures or nearby terrain obstacles." For this analysis, 40 CFR 51.1(ii) defines nearby as "that distance up to five times the lesser of the height or the (projected) width dimension of a structure, but not greater than 0.8 km ... .

"According to 40 CFR 51.1(ii), GEP stack height means the greater of the following 3 factors.

1. 65 meters, measured from the ground-level elevation at the base of the stack,
2. For stacks in existence after January 12, 1979,

   $Hg = H + 1.5 L$

   Where:

   Hg = GEP stack height

   H = height of nearby structure(s) measured from the ground level elevation at the base of the stack.

   L = lesser of height or projected width of nearby structures.

3. The height demonstrated by fluid model or field study which satisfies the definition of GEP in Section 123 of the Clean Air Act.

This GEP stack height analysis will be based upon the EPA (1985) guideline document. The GEP determination will be made for each building, and then the stack will be associated with the nearby building which would result in the greatest GEP. The stack height for the SQI has not been specified at this time. When the stack height is finalized the GEP analysis described above will be performed to determine if building downwash of the stack gases could occur and if building downwash effects will be incorporated into the modeling analyses.

SECTION 2
AIR QUALITY MODELING PROTOCOL

2.1 MODEL SELECTION

Models to be used as input to the exposure assessment and establishment of numerical limits for the incinerator will be EPA-approved UNAMAP Version VI dispersion models and an enhanced version of a UNAMAP model which calculates dry and wet deposition. The procedures used in executing the models will follow those outlined in EPA's Guideline on Air Quality Models (Revised) (1986a, 1987a).

A preliminary review of the geographical setting and a review of the land use pattern near the Rocky Mountain Arsenal was conducted to classify land use for modeling purposes, according to the method of Auer (1978; copy attached). The preliminary review was based on inspection of the typographic maps of the SQI incinerator location out to 3 km. Based on their approximate evaluation, it was determined that greater than 50% of land use was rural. Therefore, models which include rural dispersion coefficients will be used to assess the air quality impact of the facility.

Furthermore, it is expected that there will be no areas near the arsenal where the terrain elevation exceeds stack top. As a result, a USEPA UNAMAP Version VI, rural flat terrain model was selected for the air quality modeling analysis for inhalable concentration calculations and a WESTON modified version of the ISCST model (WESTDEP) was selected for wet, dry, and total deposition calculations. Each of these models are described in the following subsections.

2.1.1 Model for Inhalable Concentrations

The Industrial Source Complex (ISC) model is a steady-state Gaussian plume model which can be sued to assess airborne pollutant concentrations from a wide variety of sources. The

ISC model is part of EPA's UNAMAP VI series models (EPA, 1986b) and consists of a short-term (ISCST) and a long-term (ISCLT) module. It is listed as an EPA-approved "Appendix A" model.

The ISCST model will be used to calculate 1-hour, 3-hour, 8-hour, 24-hour, and annual air concentrations from the facility at receptors no higher than the stack height plus its base elevation. Receptor elevations higher than this are treated by the model as elevations equal to stack height plus base elevation. If the proposed stack height is less than the formula GEP stack height, building wake-effect induced downwash will be accounted for in the model otherwise no downwash effects will be evaluated.

2.1.2 Model for Deposition

The two major mechanisms for the accumulation of materials in surface soils and in surface water are wet and dry deposition. No EPA-approved model or modeling techniques currently exist which appropriately calculate both dry and wet deposition due to source emissions. WESTON has modified the EPA ISCST model to calculate wet, and total dry deposition as suggested in EPA guidance (EPA 1986c). A discussion of the WESTON approach to model these processes is included below.

2.1.2.1 Dry Deposition

Dry deposition is driven by atmospheric processes, the properties of the surfaces upon which materials deposit, and the properties of the particles being deposited. Previous studies of dry deposition have used only gravitational settling velocities to remove particles from the atmosphere. In particular, the EPA's Industrial Source Complex (ISC) model, which contains a gravitational algorithm, has been used in the past to calculate dry deposition. However, this model generally could not account for the properties of the particles deposited, the properties which effect dry deposition, or hourly meteorological effects other than stability.

Work by Sehmel and Hodgsen (1978) has resulted in a parameterization of the dry deposition process which takes more fully into account hourly meteorological conditions (e.g., wind speed, stability, etc.), particle properties (e.g., density, size) and the surface properties (e.g., surface roughness) upon which material is dry deposited.

The basic approach to dry deposition involves calculation of the ambient ground level concentration and the deposition velocity. The deposition flux is given by:

$$-F = V_d * X_i$$

Where:

$-F$ = downward flux of material (dry deposition).

V_d = the deposition velocity.

X_i = is the ambient concentration for pollutant i.

Therefore, if an estimate of the deposition velocity and the ambient concentrations for a pollutant can be made, then the dry deposition flux can be calculated. Ransieri and Croes of the California Air Resources Board (CARB) have developed computer algorithms based on Sehmel and Hodgsen's work which provide hourly values of dry deposition velocity using pre-processed meteorological data which can be obtained using the EPA preprocessor program.

WESTON has modified the EPA UNAMAP Version VI of the ISCST model to incorporate the CARB algorithms to calculate dry deposition and renamed the model WESTDEP. The WESTDEP model calculates hourly ambient ground-level pollutant concentrations as well as hourly deposition velocities to predict the dry deposition flux at each receptor. The model is conservative in that no plume depletion is assumed so that the computed air concentration and deposition rates represent the upper bound limit values. The WESTDEP model allows for building wake effects, terrain adjustments, and incorporates a separate surface roughness coefficient (z_o) for each receptor. Source information required for the model include:

- Source emission parameters:
- Stack height;
- Stack gas velocity;
- Stack gas temperature;
- Pollutant emission rate;
- Building dimensions (for wake effects options);
- Mass particle size distribution.
- Particle density, by size (2 grams/cm^3 will be used for all particle sizes).

The particle size distribution used in the modeling will be based on specification, design and control efficiency of the selected air position control equipment for the incinerator. Meteorological information required is provided by the standard UNAMAP meteorological preprocessor file. In addition, a value for the surface roughness coefficient (Z_o) must be supplied for each receptor. Based upon the typical land use around the RA, a Z_o will be conservatively selected and used in the air quality modeling to represent the impact area. WESTDEP model output includes annual average pollutant concentration at each receptor, total annual dry deposition at each receptor, and average annual dry deposition velocity at each receptor.

2.1.2.2 Wet Deposition

The wet deposition process involves removal of particles via precipitation. Currently, no widely accepted wet deposition models are available. Several studies have developed mechanisms for removal of particles from the atmosphere during precipitation events. These studies assume that particle washout or scavenging is proportional to the mass of the plume exposed to the precipitation event, the intensity and duration of the event, and the size distribution of the particles in the plume, (Radke et al., 1980, Scire and Lurman, 1983).

The scavenging coefficients which have developed in these studies are themselves based on a very limited number of original studies and are generally related to removal of sulfate

aerosols. For example, the work of Scier and Lurman is for sulfate and nitrate aerosols. Radke et al. included measurements in power plant, pulp and paper boilers and volcanic plumes which all have large concentrations of sulfate aerosols. Since these aerosols are hygroscopic, i.e., they have a great affinity for absorbing water in the air, it is likely that scavenging coefficients based on these sources will be higher than for other less water-soluble species such as the pollutants emitted by the facility. Unfortunately, there is no quantifiable data available upon which to base a more reasonable scavenging coefficient. Therefore, the scavenging coefficients used in the WESTDEP model are conservative and provide an upper bound on the amount of wet deposition likely to occur in the area of the RMA.

The EPA (EPA, 1986c) has developed an algorithm which uses scavenging coefficients to calculate wet deposition based on the work of Bowman (1987), and Radke (1980). The algorithm developed includes particle size and rainfall intensity dependent washout coefficients to calculate wet deposition. Table 2-1 includes the scavenging coefficients that will be used in the modeling analysis. The algorithm is based on the mass of pollutants in a vertical column of air which extends from the bottom to the top of the plume. WESTON has integrated this algorithm into the WESTDEP model in order to conservatively calculate wet deposition due to precipitation events.

In order to compute wet deposition, the same information used for the dry deposition calculation is required (i.e., source emission characteristics and hour-by-hour meteorology). In addition, rainfall intensity and rainfall type (e.g., thunderstorm, showers, steady precipitation) is also needed. Furthermore, the WESTDEP model has been modified to compute dry deposition only when no wet deposition i.e., no rainfall is occurring.

The WESTDEP model has been approved for use in the preparation of numerous health risk assessments for hazardous waste incinerators and resource recovery facilities in Kentucky, Maryland, Michigan, Minnesota, New Jersey, Pennsylvania, and Rhode Island.

Therefore, the wet and dry algorithms, which are now a part of the WESTON modified EPA ISC model (WESTDEP) enable WESTON to predict total deposition due to emissions from specific facilities for use in multipathway risk assessments.

2.2 MODEL INPUT DATA

In addition to emission rates and physical emission characteristics of the incinerator other input data are needed to estimate the incremental and overall air quality impact of the incinerator. Specifically, a receptor grid network, meteorological data, and model options are required as input to both the ISC and WESTDEP models.

2.2.1 Receptor Grid Network

A coarse receptor grid network will be established to find the approximate location of maximum estimated air quality impact due to emissions from the facility. From this analysis, the nearest critical receptor(s) can be identified for evaluation in the exposure analysis. A polar coordinate system with a radial every ten degrees beginning with north, centered upon the stack will be used as a basis for receptor deployment for the ISC model application. Receptor points for ISCST will be placed at the following distances from the stack: 2,000m, 2,500m, 3,000m, 4,000m, 5,000m, 6,000m, 8,000m, 10,000m, 12,000m 15,000m, 17,500m, 20,000m, 22,500m and 25,000m. Terrain elevations selected for the receptor grid will be based upon the highest contour between the receptor point and half the distance to any neighboring receptor point. Discrete receptor points will be located at sensitive areas such as hospitals, schools, parks, etc., and along the property line of the RMA. A refined receptor grid with spacing of 100 meters will be used in areas of maximum concentrations identified by the initial course receptor grid. Receptors points will also be placed in 100 meter increments along 10 degree radials from the RMA property line to the first receptor ring. No receptor points will be placed within the RMA property.

Table 2-1

Scavenging Coefficients

Rainfall Intensity	Particle Size Categories (Microns) $<2\mu$	$2\text{-}10\mu$	$>10\mu$
Light[a]	0.22×10^{-3}	0.18×10^{-3}	0.969×10^{-2}
Moderate[b]	0.56×10^{-3}	0.893×10^{-3}	0.969×10^{-2}
Heavy[c]	0.146×10^{-2}	0.464×10^{-2}	0.969×10^{-2}

(a) Light is less than 0.1 inches per hour.
(b) Moderate is 0.11-0.3 inches per hour.
(c) Heavy is greater than 0.31 inches per hour.

2.2.2 Meteorological Data

The meteorological data base for the modeling of annual impacts will consist of surface data collected at the Denver Stapleton Airport, for the most recent, available five-year period 1985-1989. The Airport is located approximately 5 miles south of the incinerator.

Selection of the meteorologic data is consistent with the recommendations in Section 6.6 of EPA's On-Site Meteorological Program Guidance for Regulatory Modeling Applications (1987). An annual wind rose for the Airport data showing the prevailing wind directions and wind speed classes is presented in Figure 2-1. Coincident mixing heights will be derived by merging surface temperatures with twice daily upper air data, both obtained from Denver Airport for the period 1985-1989. The raw meteorological surface data and mixing heights will be prepared for input to the ISCST models by using the EPA preprocessor program. Precipitation data from the Denver Airport during the period 1985-1989 will also be merged with the preprocessed data for use in the WESTDEP model for deposition calculations.

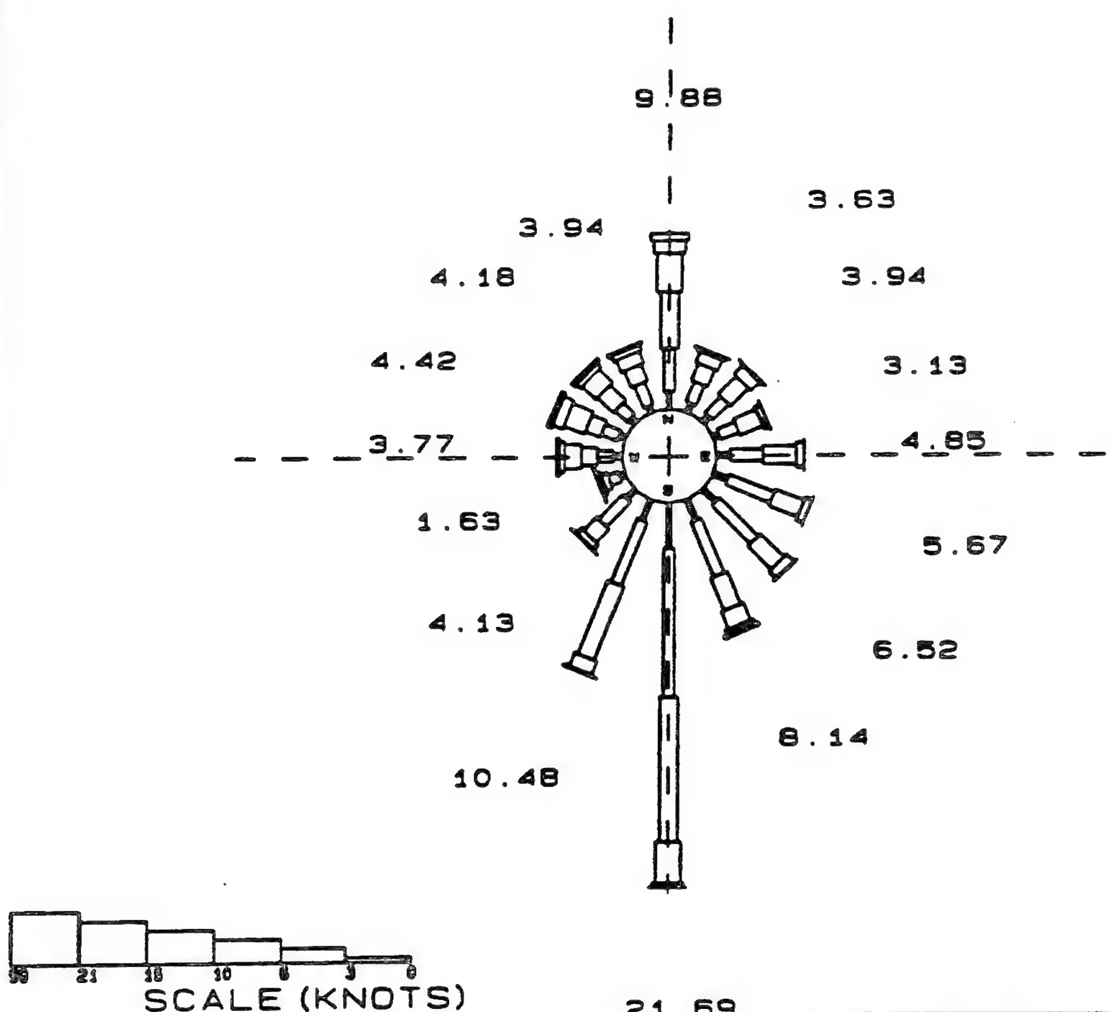
2.2.3 Model Options

The ISCST model has various options to simulate different dispersion conditions for emissions from a stack. The U.S. EPA has recommended (EPA, 1986a) various options to be used in dispersion modeling for regulatory purposes. These recommended regulatory default options, shown in Table 2-2, will be used in the air quality impact analysis for the incinerator.

2.3 AIR QUALITY ANALYSIS

The air quality analysis will be conducted using the models, options, and procedures discussed in previous sections of this protocol. The WESTON model will be employed to estimate annual concentrations, wet/dry and total depositions for each of the five years

DENVER, COLORADO
YEAR: 1988
CALMS INCLUDED



	WIND SPEED (KNOTS) PERCENT OCCURRENCE					
	0-3	3-6	6-10	10-16	16-21	>21
N	0.86	2.47	3.29	2.14	0.72	0.40
NNE	0.81	1.22	1.06	0.65	0.18	0.02
NE	0.45	1.25	1.41	0.55	0.13	0.03
ENE	0.34	1.09	1.34	0.33	0.02	0.00
E	0.73	1.86	1.80	0.43	0.03	0.00
ESE	0.89	2.69	1.66	0.41	0.02	0.00
SE	0.68	3.07	1.86	0.85	0.06	0.00
SSE	1.24	3.39	1.98	1.07	0.28	0.17

	WIND SPEED (KNOTS) PERCENT OCCURRENCE					
	0-3	3-6	6-10	10-16	16-21	>21
S	2.82	8.44	8.17	2.30	0.24	0.02
SSW	1.26	3.86	4.47	0.79	0.09	0.02
SW	0.70	1.92	1.05	0.39	0.06	0.02
WSW	0.34	0.60	0.35	0.19	0.09	0.05
W	0.45	0.94	0.94	0.97	0.26	0.20
WNW	0.39	0.97	0.81	1.29	0.59	0.27
NW	0.38	0.92	1.24	1.08	0.33	0.23
NNW	0.38	1.33	1.01	0.74	0.33	0.14

FIGURE 2-1

1985-1989. Since the expected operational period for the SQI is 18 months, the year with the highest concentration and deposition rates will be used as input to the risk assessment.

Table 2-2

Regulatory Default Options
Proposed for the ISCST Model

- Stack-tip downwash.
- Final plume rise.
- Buoyancy induced dispersion (BID).
- Vertical potential temperature gradients of 0.0, 0.0, 0.0, 0.0, 0.02, 0.035, for stability classes A through F, respectively.
- Automatic treatment of calms.
- Wind profile exponents of 0.07, 0.07, 0.010, 0.15, 0.35, 0.55 for stability classes A through F, respectively.
- Infinite pollutant half-life.

2.4 REFERENCES

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SECTION 3
RISK ASSESSMENT PROTOCOL

3.1 INTRODUCTION

The objective of the health risk assessment to be conducted by WESTON for Rocky Mountain Arsenal (RMA) is to assist in the establishment of chemical emissions limits for the Basin F Submerged Quench Incinerator (SQI). The resultant emissions limits are to be protective of human health, as stated in the Final Decision Document (May, 1990). The risk characterization results and a discussion of ARARs will be initially presented in the Implementation Document to be submitted to RMA on December 14, 1990, and which will be used to evaluate possible design changes in the SQI. The detailed risk assessment document will be submitted immediately thereafter.

The purpose of this section of the protocol is to present the specific methodology and exposure assumptions to be used by WESTON in the risk assessment. Preliminary data concerning the contaminants of concern are also initially presented. In addition to the Final Decision Document, the approach and methodology draws upon the guidance set forth in the recently revised U.S. EPA Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (EPA, 1989a) and the U.S. EPA Methodology for Assessing Health Risks Associated With Indirect Exposure to Combustor Emissions (EPA, 1990a). These and other pertinent guidance documents are indicated in the appropriate sections, and are listed in the protocol in Subsection 3.7.

A risk assessment for the proposed SQI was previously performed by Woodward-Clyde Consultants (Jan., 1990) to assist in the screening and selection of interim remedial actions (IRAs) as required under CERCLA and the National Contingency Plan. Additionally, on-site (Ebasco Report) and off-site (HLA/ESE Report) human health risk assessments have been performed for RMA with respect to worker and residential exposures, respectively, to existing onsite contamination. To maintain consistency with these studies, WESTON

reviewed the data from these previous on-site and off-site evaluations and, where relevant utilized previously developed exposure assumptions and input parameters, toxicity criteria and background data. These parameters have been appropriately cited in the remainder of this protocol or its attachments.

This risk assessment will be a comprehensive evaluation of both direct and indirect exposure pathways, and will use as the basis for estimating human exposure the results of the air dispersion and deposition modeling, the methods of which are described in Section 2 of this protocol. To be consistent with the most recent EPA guidance (EPA, 1989a; 1990a), WESTON will be considering certain pathways of indirect exposure that were not originally considered in the SQI risk assessment as part of the IRA prepared by Woodward-Clyde Consultants (Jan., 1990). These additional pathways include: breast milk consumption; ingestion of fish from contaminated surface waters; vegetable root uptake of metals and organics; and, beef and dairy cattle exposure with subsequent human consumption of homegrown or commercially-produced beef and cow's milk.

In accordance with the guidance set forth in the Final Decision Document, the risk assessment process will be used to establish emission limits as follows:

- Emission rates (both average and upper 95% confidence limits, where possible) will be determined from evaluation of historical waste stream characterization data, test burn data, and WESTON's hazardous waste incinerator emissions inventory, as described in detail in Section 3.2.

- These emissions data will be used in conjunction with the air modeling, exposure assessment and toxicity assessment results to calculate noncarcinogenic hazard indices and carcinogenic risk for each chemical and pathway in each proposed exposure scenario.

- As directed in the Final Decision Document (p.9-6), cumulative excess carcinogenic risk and noncarcinogenic hazard indices will be determined for each exposure scenario. Assuming excess cancer risk does not exceed 1E-06, and the noncarcinogenic hazard index does not exceed 1 for the nearest most reasonable maximally-exposed individual, the emission rates for the contaminants of concern will be considered protective of human health. WESTON has developed four exposure scenarios, described in detail in Section 3.4.1, which represent reasonable maximally-exposed individuals in the vicinity of the facility. The facility is assumed to operate for two years.

- Should the cumulative cancer risk or noncarcinogenic hazard index exceed the limits described above for the most reasonable maximally-exposed individual, each contaminant and pathway assessed in that scenario will be evaluated to develop a profile of the major contributor(s) to risk. A report summarizing these findings will be presented to the appropriate agencies, as outlined in the Final Decision Document, to determine whether a change in the design of the treatment system is necessary.

The protocol is divided into four sections:

1. Contaminant Identification, Selection and Emission Rate Determination (Section 3.2)

2. Toxicity Assessment (Section 3.3)

3. Exposure Assessment (Section 3.4)

4. Risk Characterization (Section 3.5)

These sections of the protocol will correspond to the general format to be used in the final risk assessment document. For the final document, detailed calculations and supporting

information that are applicable to the material presented in each of the sections of the final risk assessment document will be included in corresponding appendices.

3.2 CONTAMINANT IDENTIFICATION, SELECTION AND EMISSION RATE DETERMINATION

Initial identification of potentially emitted contaminants, and estimation of their emission rates will be based on an analysis of the composition of the waste stream and its theoretical products of incomplete combustion, valid test burn data, and comparison with WESTON's hazardous waste incinerator emissions database. This approach should be consistent with the Final Decision Document and yield a very conservative estimate of the emitted chemicals and their likely emission rates. This information will be supplemented or verified by additional Basin F liquid analyses being conducted currently, if the analytical results are available when the contaminant identification phase of the risk assessment is performed.

3.2.1 Contaminant Identification

Four groups of pollutants and their respective emission rates will be developed. These chemicals are generally categorized as principal organic hazardous constituents (POHCs), products of incomplete combustion (PICs), metals, and criteria pollutants (gases, particulates, and acid gases). The detailed lists of initially identified potential pollutants and emission rates are presented in Tables 1 and 2 (Appendix A). The remainder of this section discusses the methodology used for selecting the chemicals of concern.

3.2.1.1 Analysis of Waste Stream Composition

The following methodology was used to evaluate the waste stream composition for the Basin F liquid material at the RMA:

- The historical characterization data from 1978 through 1988 for the basin and the recent WESTON analyses for the pond and for the tanks were converted to a common basis of mg/l. (This involved a density correction considering the 1.24 g/ml density of the waste for the historical data that had been reported as ppm or ppb).

- The average and maximum of the reported values were taken for the values from the basin, pond and tank, each taken separately. (If a range was reported for a particular source of analyses, the midpoint of the range was assumed to represent the average).

- The maximum of the average values of the basin, pond and tank analyses were calculated, as well as the maximum of the maximum values.

- The maximum of the average and maximum of the maximum values were summed for all compounds (organics and metals).

- Because the total of the maximums of the maximum values was about 1 million mg/l, or about 100%, this approach was considered too overly conservative, even for risk assessment purposes. The total of maximums of the averages, however, was about 640,000 mg/l (about the same value as the portion of the waste stream that is not water).

Therefore, the maximums of the average values from each of the basin, pond, and tanks were taken as a reasonable worst case estimate of the composition of the waste stream. These values were then converted to tons of component per year for the design incinerator capacity of 10,325 lb/hr. These data were used by Dr. Barry Dellinger to predict the PICs and POHCs as discussed in more detail below.

3.2.1.2 Evaluation of Test Burn Data

Emissions testing results conducted during the test burns of Basin F waste performed by T-Thermal (August, 1990) were evaluated by the WESTON Air Permitting and Engineering staff. A number of the test runs were considered unacceptable for emissions estimation because of feed clogging followed by rapping or oxygen blasts into the feed nozzles. Two dioxin/furan runs, and one metals run were considered valid. The remaining runs have been discarded for evaluation purposes.

Compared to other hazardous waste incinerators, the dioxin/furan TEF for the two runs appears relatively small (0.06 ng/Nm3) compared to WESTON's emissions database values. However, the risk this poses cannot as yet be determined. For the risk analysis base case (i.e., average conditions), we will use the average of the two test burn runs; for the sensitivity case (i.e., upper bound conditions), we will use the upper 95% confidence limit of the WESTON database for hazardous waste incinerators.

The test burn data for the one acceptable run for metals compare well with the emission estimates based on the waste stream data (average of the maximums) and removal efficiencies published by the U.S. EPA for hazardous waste incinerators. Therefore, we will use the maximum of these two data sets for the base case. U.S. EPA Tier I and Tier II guidance values, values based on the "maximum of the maximums" of the waste stream data and emission test runs from the test burn will be considered in the sensitivity analysis.

For pesticides and PCBs, we will use Dr. Dellinger's POHC and PIC data. These potential pollutants were not detected during the test burn emission testing

3.2.1.3 Key Organic Pollutants in the Waste Profile

Organic compounds were identified either as POHCs from an analysis of the waste stream composition (Section 3.2.1.1) or from the analysis of PICs resulting form combustion of the

POHCs (Section 3.2.1.4). Toluene was predicted to be the most difficult compound to destroy, and, therefore it was used to normalize destruction removal efficiency (DRE) for all POHCs by assuming toluene would be destroyed with a 99.99% DRE as verified by a trial burn. Historical data indicate that organics present in the waste stream include volatiles, semi-volatiles, and pesticides. Dioxins and furans, determined from an evaluation of the test burn data discussed above, are listed separately and are expressed as toxic equivalents based on the most recent U.S. EPA guidance (EPA, 1989b).

3.2.1.4 Products of Incomplete Combustion (With or Without Precursors)

Products of incomplete combustion (PICs) are organic compounds present in emissions from an incinerator and which are formed from the thermal breakdown of chemicals present in the waste stream, reformation reactions, or some other process subsequent to incineration (Trenholm and Hathaway, 1984; Oppelt, 1987). Specific PICs, with or without precursors, have been identified and their emission rates estimated by Dr. Barry Dellinger, who has been subcontracted for this effort.

3.2.1.5 Metals

Identification of metals and determination of their emission rates will be based on waste stream characteristics, test burn data and the U.S. EPA guidance document as discussed under Section 3.2.1.2.

3.2.1.6 Criteria Pollutants and Acid Gases

Selected criteria pollutants (particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide) and acid gases (primarily hydrogen chloride and hydrogen fluoride) will be evaluated both for potential acute and chronic health effects by the inhalation pathway. Their emissions rates were determined from test burn data, vendor guarantees and WESTON's hazardous waste emissions inventory database.

3.2.2 Emission Rates

Table 1 of Appendix A summarizes the initial list of emitted organic and inorganic chemicals with estimated emissions rates. Base case emissions rates are conservatively high estimates of the emissions which would be expected during the course of normal operation. Their methods of determination are footnoted in the table. Sensitivity case emissions rates represent upper bound or maximum worst case expected rates. Refer to the footnotes in Table 1 for specific methods of determination. Criteria pollutants, gases, and particulates are presented in detail in Table 2.

3.2.3 Final Selection of Contaminants of Concern

The final contaminants of concern will be selected from the initial list for each medium of potential exposure (air, soil, surface water) based on various conservative criteria discussed in detail below. The purpose of this part of the evaluation is to eliminate from the large list of chemicals those that will not be of significance in the risk characterization.

3.2.3.1 Air

All contaminants, both carcinogens and noncarcinogens, will be evaluated in the air pathway, including the criteria pollutant gases and particulates.

3.2.3.2 Soil

All carcinogens (by the oral route) will be retained for final evaluation in all soil pathways. Volatile organics (VOCs) will be excluded from soil pathways based on the following rationale:

- VOCs are likely to be emitted as vapors
- VOCs are unlikely to be deposited in soils following their emission
- VOCs are unlikely to be persistent in soil, if deposited

For purposes of this screening procedure, a VOC is defined as any chemical (carcinogen or noncarcinogen) with a vapor pressure greater than 1E+02 mm Hg and/or Henry's Law constants greater than 1E-03 atm-m^3/mol (Lyman, et al., 1982). The vapor pressure criterion was derived from inspection of the range of vapor pressures of chemicals that EPA classifies as volatiles (EPA, 1986).

Metals (except oral carcinogens) were screened based on comparison with regional background metals concentrations. Background data were obtained from data WESTON gathered for Rocky Flats (WESTON, 1989). Metals were excluded from further analysis through soil pathways if their predicted soil concentrations based upon the maximum total deposition at the points of exposure (refer to Section 3.4.1 for specific locations of reasonable maximally-exposed individuals) were greater than or equal to 1 percent of the mean background concentrations for the respective metal.

3.2.3.3 Surface Water

Land use evaluation and the deposition modeling isopleths revealed that Engineer's Lake, a designated manmade recreational fishing area (refer to Section 3.4 for more detail) was impacted by facility emissions. Contaminants of concern were evaluated for consideration in the surface water pathway (i.e., fish consumption) based on several criteria:

- all oral carcinogens will be included in the final surface water pathway evaluation

- VOCs were excluded from this pathway based on the same rationale as previously discussed for soils

- a modified Tier I analysis was performed to evaluate the remaining chemicals for possible exclusion from the surface water pathway. The basis of this screening analysis is to estimate a highly conservative concentration of the

chemical contaminants in the impacted surface water body and compare this to the Ambient Water Quality Criteria (AWQC) for fish consumption by humans. If a chemical had no designated AWQC, it was excluded from this analysis, and will be included in the more detailed surface water pathway evaluation in the actual risk assessment. The total areal deposition for the 32 acre watershed of Engineer's Lake was determined from the modeled isopleths. Lakewater concentrations for each chemical were determined by dividing the total amount deposited in the lake by the total volume of the lake. It was conservatively assumed that the lake had a 0.5 year hydraulic retention time and that all chemicals adsorbed to soil runoff was desorbed into the water. Table 3 in Appendix A shows the results of this analysis. It was concluded that the nine chemicals evaluated in this screen could be excluded from further evaluation based on the criterion that their conservatively predicted water concentrations were less than 10 percent of their respective AWQCs.

3.3 TOXICITY ASSESSMENT

The Integrated Risk Information System (IRIS) computer data base (EPA, 1990b) will be referred to for the most recent U.S. EPA reference doses and cancer potency factors. Other EPA sources, including EPA's quarterly Health Effects Assessment Summary Tables (EPA, 1990c), will also be used for those chemicals for which toxicity values are unavailable on IRIS.

For those chemicals for which EPA-derived potency factors or reference doses are unavailable, toxicity values will be derived from health-based criteria or toxicity data. Derived toxicity values published in the on-post and off-post exposure assessments will be used if possible. All approaches for the derivation of reference doses or cancer potency factors will be fully discussed in the risk assessment. The use of derived toxicity values and the methods by which they will be derived will be subject to the review of U.S. EPA Region

VIII and RMA. Tables 4A and 4B in Appendix A list the chemicals of concern with their carcinogenic slope factors and reference doses, respectively.

To evaluate dioxins and furans, WESTON will follow, if applicable, the guidelines set forth in the Interim Procedures for Estimating Risks Associated with Mixtures of CDDs and CDFs (EPA, 1989b).

3.4 EXPOSURE ASSESSMENT

3.4.1 Exposure Scenarios

The exposure scenarios have been evaluated based upon the air dispersion and deposition modeling results. Theoretically, to determine emissions limits, it is necessary to evaluate only one scenario, the most reasonable maximally-exposed individual (RMEI). Reasonable maximum exposure is defined by the U.S. EPA as "the highest exposure that is reasonably expected to occur at a site" (EPA, 1989a). However, the RMEI cannot always be determined based on the modeling results alone. Therefore, it is recommended that several exposure scenarios be evaluated in the risk assessment. The scenario ultimately resulting in the greatest risk (i.e., most exposed), as directed in the Final Decision Document, will be used to assess numerical chemical emissions limits.

Based on available information regarding current off-site and on-site land usage, and the results of the air deposition modeling, four potential RMEIs have been identified. The scenarios presented below represent present use conditions. No future use scenarios were included since hypothetical exposures in this case would not likely exceed any present use exposures; this is based on the assessment that pathways of exposure and areas of maximum impact of emissions would not be different from any present use condition. The four potential RMEIs are:

- An individual currently living within the residential area where total deposition (dry plus wet) is maximal (i.e., just south of the property fenceline).

- An individual currently living within the residential area where dry deposition will be maximal (i.e., just north of fenceline).

- An individual currently living on a local cattle farm where total deposition is highest for that land use (i.e., just northwest of site).

- A maintenance worker on the site who is exposed to an area weighted air concentration and wet/dry deposition as determined from the modeling results.

The respective locations of these RMEIs are indicated on the site diagram in Appendix A (Figure 1). The isopleths developed for the air modeling are not provided here but will presented in the final report. Note that all residential exposure scenarios include a fish consumption pathway based on the finding that Engineer's Lake, a recreational fishing area, is impacted by the deposition analysis. The Lake is located just west of RMA near Adams City.

Subsections 3.4.2 through 3.4.4 detail the specific equations or approaches for determining media concentrations, and the exposure algorithms and input parameters that will be employed by WESTON in determining estimated daily intakes (i.e., doses) of each of the pollutants. When available, site-specific or more recently developed input factors (e.g., ingestion rates) will be used in preference to the factors presented in the protocol. Table 5 of Appendix A is a summary of the key input parameters for air and soil pathways which has been developed in consultation with Dr. Chris Weis of EPA VIII and following a review of the offsite and onsite exposure assessments performed previously for RMA. Additional parameters are discussed with the algorithms in Sections 3.2.2 through 3.2.4. Depending on the results of the evaluation of local land and water usages and final contaminant pathways

analysis, it is possible that some of these algorithms will not be included. The exposure algorithms presented in these subsections estimate daily exposure doses based on expected media concentrations determined through the dispersion and deposition modeling results. Adjustments to lifetime exposure doses will be determined in the risk characterization section. Section 3.5 discusses this in more detail.

A groundwater exposure pathway has not been included in this protocol. It has been WESTON's experience that groundwater contamination from incinerator facility emissions is minimal and makes no significant contribution to total risk. Current EPA guidance for assessing health risks associated with combustor emissions indicates that the evaluation of the groundwater pathway is unnecessary due to limited potential for groundwater contamination (EPA, 1990a). However, should groundwater recharge patterns and private well use be significant factors at the proposed site, this pathway can be further evaluated.

3.4.2 Inhalation Exposure

3.4.2.1 Air Concentrations of Pollutants

The concentrations of pollutants in the ambient air will be determined based on the dispersion modeling results.

3.4.2.2 Exposure through Inhalation

$$\underset{(\text{mg/kg/day})}{\text{Dose From Inhalation}} = \underset{(\text{mg/m}^3)}{\text{Ambient Air Concentration}} \times \underset{(\text{m}^3\text{/day})}{\text{Respiration Rate}} \times \underset{(\text{kg})}{\frac{1}{\text{Body Weight}}}$$

Where:

- Respiration Rate = 20 m^3/day - adult (EPA, 1989c), 10 m^3/day - child (USNRC, 1977), 3.8 m^3/day - infant (NCRP, 1984)

- Body Weight = 70 kg - adult, 15.5 kg - child, 9 kg - infant (0-1 yr old) (EPA, 1989c; EBASCO, 1989)

3.4.3 Ingestion Exposure

3.4.3.1 Soil Concentrations of Pollutants

Contaminants with no expected significant degradation:

$$\text{Maximum Contaminant Concentration in Soil (mg/kg)} = \frac{\text{Total Deposition Rate (g/m}^2\text{/year)} \times \frac{10^3\ \text{mg}}{\text{g}} \times \text{Expected Facility Life (years)}}{\text{Soil Density (kg/m}^3) \times \text{Soil Mixing Depth (m)}}$$

Where:

- Expected Facility Life = 2 years
- Soil Density = site specific
- Soil Mixing Depth = 0.1 m (for untilled soil) (EPA, 1990a)
  = 0.2 m (for tilled soil) (EPA, 1990a)

Contaminants with expected significant degradation:

$$\text{Maximum Contaminant Concentration in Soil (mg/kg)} = \frac{1-e^{(-kt)} \times \text{Total Deposition Rate (g/m}^2\text{/year)} \times \frac{10^3\ \text{mg}}{\text{g}}}{k \times \text{Soil Density (kg/m}^3) \times \text{Soil Mixing Depth (m)}}$$

Where:

k = Decay Coefficient (yr^{-1}), chemical specific

t = Expected Facility Life = 2 years*

*An average concentration is also calculated for the contaminants with expected loss using a computerized model which takes into account daily degradation over 70 years.

3.4.3.2 Exposure from Soil/Dust Ingestion

$$\text{Contaminant Dose from Soil/Dust} = \frac{\begin{matrix}\text{Contaminant Concentration} \\ \text{in Soil/Dust} \\ \text{(kg/day)}\end{matrix} \times \begin{matrix}\text{Soil/Dust} \\ \text{Ingestion Rate} \\ \text{(mg/kg)}\end{matrix}}{\text{Body Weight (kg)}}$$

Dust concentrations are assumed to be equal to the 0.1 m mixing depth soil concentrations and are calculated collectively with soils concentration.

Where:

- Annual average soil/dust ingestion rate = 5.0E-05 kg/day - adult maintenance worker (EBASCO); 1.0E-04 kg/day - adult farmer resident (EPA, Region VIII); 2.0E-04 kg/day - child farmer/resident (EPA, Region VIII).

- Body Weight = 70 kg - adult, 15.5 kg - child (EPA, 1989c; EBASCO).

3.4.3.3 Garden Produce Ingestion

$$\begin{matrix}\text{Contaminant} \\ \text{Concentration} \\ \text{in/on} \\ \text{Produce} \\ \text{(mg/kg)}\end{matrix} = \begin{matrix}\text{Contaminant} \\ \text{Concentration} \\ \text{in Soil} \\ \text{(mg/kg)}\end{matrix} \times \begin{matrix}\text{Root} \\ \text{Uptake} \\ \text{Factor}\end{matrix} + \begin{matrix}\text{Dry} \\ \text{Deposition} \\ \text{Rate} \\ (\text{g/m}^2\text{/year})\end{matrix} \times \begin{matrix}\text{Vertical Surface} \\ \text{Deposition} \\ \text{Factor} \\ (\text{m}^2\text{sec/kg})\end{matrix} \times \frac{\text{g}}{10^3\ \text{mg}} \times \frac{3.15\text{E}+07\ \text{sec}}{\text{yr}}$$

For root vegetables, the second term of this equation (i.e., the contribution of contaminant deposition on the plant) drops out. The second term also drops out when calculating the contaminant concentrations in/on leafy vegetables and garden fruits during the years after the facility is closed.

Where:

- Soil concentration is calculated with an assumed mixing depth of 20 cm (EPA, 1990a).

- Root Uptake Factor - chemical specific (inorganics: Baes et al., 1984; organics calculated based on Briggs et al., 1982 (root vegetables) and Travis and Arms, 1988).

- Vertical Surface Deposition Factor $= \dfrac{r\,(1-e^{-kt})}{yk}$

r	=	Interception fraction of the plant (unitless) (Baes et al., 1984).
k	=	Total rate constant for degradation process ($seconds^{-1}$) (Baes et al., 1984).
t	=	Growing Time (seconds)
y	=	Plant Yield (wet weight) (kg/m^2)

$$\begin{aligned}\text{Contaminant Dose from Produce Ingestion (mg/kg/day)} = {} & \text{Contaminant Concentration in Leafy Vegetables (mg/kg)} \times \text{Leafy Vegetable Consumption Rate (kg/day)} \times \text{Fractions Homegrown} \; + \\ & \text{Contaminant Concentration in Root Vegetables (mg/kg)} \times \text{Root Vegetable Consumption Rate (kg/day)} \times \text{Fraction Homegrown} \; + \\ & \text{Contaminant Concentration in Garden Fruits (mg/kg)} \times \text{Garden Fruit Consumption Rate (kg/day)} \\ & \times \text{Fraction Homegrown} \times \frac{1}{\text{Body Weight (kg)}}\end{aligned}$$

Where:

- Consumption Rates in Wet Weight (calculated from EPA, 1990 and Baes et al., 1984).

  leafy vegetables = 1.19E-02 kg/day - adult; 1.24E-03 kg/day - child.

  root vegetables = 6.53E-02 kg/day - adult; 3.11E-03 kg/day - child.

  garden fruits = 6.4E-02 kg/day - adult; 3.34E-02 kg/day - child.

- Body Weight = 70 kg - adult, 15.5 kg - child (EPA, 1989c; EBASCO).

- Fraction Homegrown = 0.58 - adult and child resident (HLA Report); 0.90 - adult and child farmer (EPA, Region VIII).

To the extent possible, local consumption rates and homegrown fractions will be further investigated as part of the land use analysis.

3.4.3.4 Surface Water Concentrations of Pollutants

If the surface water pathway is determined to be a key exposure route, surface water concentrations will be determined using a Tier 2 analysis (EPA, 1990a). If requested, the details of the surface water model will be provided in a supplementary memorandum.

3.4.3.5 Drinking Water Ingestion

$$\text{Contaminant Dose from Surface Water Ingestion (mg/kg/day)} = \text{Estimated Surface Water Concentration (mg/L)} \times \text{Surface Water Consumption Rate (L/day)} \times \frac{1}{\text{Body Weight (kg)}}$$

Where:

- Surface Water Consumption Rate = 1.4 L/day - adult, 1 L/day - child (EPA, 1989c)

- Body Weight = 70 kg - adult, 15.5 kg - child (EPA, 1989c; EBASCO).

3.4.3.6 Fish Ingestion

$$\text{Contaminant Concentration in Fish (mg/kg)} = \text{Contaminant Concentration in Water (mg/L)} \times \text{Adjusted Bioconcentration Factor (L/kg)}$$

Where:

- Adjusted Bioconcentration Factor: compound specific, adjusted to account for difference in lipid content in test and study organism (if information is available) =

  $$\text{Bioconcentration Factor} \times \frac{\text{LC Study}}{\text{LC Test}}$$

Where:

- LC study = Lipid concentration in study organism
- LC test = Lipid concentration in test organism

If data are available, an adjustment of the predicted contaminant concentration in the whole body of the fish to a concentration in the edible portion of the fish will be made.

$$\text{Contaminant Dose from Fish Ingestion (mg/kg/day)} = \text{Contaminant Concentration in Fish (mg/kg)} \times \text{Daily Fish Consumption Rate (kg/day)} \times \frac{1}{\text{Body Weight (kg)}}$$

- Fish Consumption Rate = 9.84E-03 kg/day - resident/farmer adult (HLA Report); 2.42E-03 kg/day - child.
- Body Weight = 70 kg - adult, 15.5 kg - child (EPA, 1989c; EBASCO).

3.4.3.7 Ingestion of Meat and Milk

$$\text{Animal Feed (Pasture Grass, Hay, Grain, and Corn Silage) Contaminant Concentration (mg/kg)} = \text{Contaminant Concentration in Soil (mg/kg)} \times \text{Root Uptake Factor} + \text{Dry Deposition Rate } (g/m^2/yr)$$

$$\times \text{ Vertical Surface Deposition Factor } (m^2 sec/kg) \times \frac{1{,}000 \text{ mg}}{\text{g}} \times \frac{\text{yr}}{3.15E+07 \text{ sec}}$$

Only the first term of the equation applies for calculating contaminant concentration in grain. The second term also drops out when calculating contaminant concentrations in/on other animal feed during the years after the facility is closed.

Where:

- Vertical Surface Deposition Factor (see Section 3.2.3).

- Root Uptake Factor - chemical specific.

$$\text{Contaminant Concentration in Animal Diet (mg/kg)} = \frac{\text{Contaminant Concentration in Animal Feed Concentration (mg/kg)} \times \text{Daily Intake of Feed (kg/day)} + \text{Contaminant Concentration in Soil (mg/kg)} \times \text{Daily Intake of Soil (kg/day)}}{\text{Daily Intake of Feed (kg/day)} + \text{Daily Intake of Soil (kg/day)}}$$

Where:

- Daily Intake

  Feed = dependent on area-specific farming practices and type of cattle

  Soil = 2 percent of grazing diet (Fries, 1986)

- Soil Concentration - Calculated using a 0.1 m mixing depth for untilled soil (e.g., pasture grass) and a 0.20 m mixing depth for tilled soil (e.g., corn, grain, hay). (EPA, 1990a).

$$\text{Contaminant Concentration In Animal Product (mg/kg)} = \text{Animal Intake (mg/kg)} \times \text{Tissue Uptake Factor (day/kg)} \times \text{Total Feed Intake}^{*} \text{ (kg/day)}$$

- Tissue Uptake Factor - contaminant specific (Baes et al., 1984; Fries, 1986; Travis et al., 1988).

* Total feed intake is not used in determining dioxin concentrations in animal products and the dioxin tissue uptake factor is unitless.

$$\text{Contaminant Dose from Animal Product Ingestion} = \frac{\text{Contaminant Concentration in Animal Product (mg/kg)} \times \text{Product Consumption Rate (kg/day)} \times \text{Fraction Homegrown Product}}{\text{Body Weight (kg)}}$$

Where:

- Product Consumption Rates:

  Beef = 0.037 kg/day - child (Pao et al., 1982), 0.067 kg/day - adult (Fries, 1986).

  Beef fat = 0.009 kg/day - child (EPA, 1986), 0.015 kg/day - adult (Fries, 1986).

  Milk = 0.39 kg/day - child (Pao et al., 1982), 0.305 kg/day - adult (Fries, 1986).

  Milk fat = 0.016 kg/day - child (EPA, 1986), 0.01 kg/day - adult (Fries, 1986)

- Fraction home-produced or obtained from a local source (rural)

  Beef = 1.00 - Farm Household (WESTON); 0.05 Residential Household - (WESTON)

Milk = 1.00- Farm Household (WESTON); 0.05 - Residential Household (WESTON).

- Body Weight = 70 kg - adult, 15.5kg - child (EPA, 1989c; EBASCO).

3.4.3.8 Breast Milk Ingestion

$$\underset{(mg/kg)}{\text{Breast Milk Concentration}} = \underset{(mg/kg/day)}{\text{Sum of Contaminant Doses to Mother}} \times \underset{(day)}{\text{Breast Milk Transfer Factor}}$$

Where:

- Sum of Contaminant Doses: Total dose through all exposure routes

- Breast Milk Transfer Factor: chemical specific (Smith, 1987; Travis et al., 1988)

The breast milk pathway will be evaluated for organic contaminants only due to insufficient information regarding breast milk transfer factors (based on estimated daily intakes) for metals in human milk.

$$\underset{(mg/kg/day)}{\text{Infant Contaminant Dose}} = \frac{\underset{(mg/kg)}{\text{Contaminant Concentration in Breast Milk}} \times \underset{(kg/day)}{\text{Milk Ingestion Rate}}}{\underset{(kg)}{\text{Infant Body Weight}}}$$

Where:

- Milk Ingestion Rate = 0.8 kg/day (Smith, 1987)

- Infant Body Weight (0-1 yr old) = 9 kg (EPA, 1989c)

3.4.4 Dermal Exposure

$$\text{Dose From Dermal Contact (mg/kg/day)} = \text{Contaminant Concentration in Soil (mg/kg)} \times \text{Exposed Skin Surface Area (cm}^2\text{)} \times \text{Soil Adherence Factor (mg/cm}^2\text{/event)} \times \text{Dermal Absorption Factor}$$

$$\times \text{Number of Exposure Events per Week (events/wk)} \times \frac{\text{kg}}{10^6 \text{ mg}} \times \frac{\text{week}}{7 \text{ days}} \times \frac{1}{\text{Body Weight (kg)}}$$

Where:

- Exposed Skin Surface (arm and hand) Area: 1,700 cm^2 - adult (EBASCO); 2,188 cm^2 - child (EPA, 1989c).

- Soil Adherence Factor - 3.5 mg/cm^2 - adult maintenance worker/farmer (EBASCO); 0.51 mg/cm^2 - resident adult and farmer/residential child (EBASCO).

- Dermal Absorption Factor = 0.01 - metals; 0.10 - organics (EBASCO).

- Body Weight = 70 kg - adult, 15.5 kg - child (EPA, 1989c; EBASCO).

3.5 RISK CHARACTERIZATION

3.5.1 Evaluation of Risk

3.5.1.1 Noncarcinogenic Risk

Noncarcinogenic risk will be evaluated for each scenario by comparing contaminant doses to chronic reference doses. The contaminant dose: reference dose ratios (i.e., hazard quotients) will be summed to calculate the total chroni hazard index. Separate hazard indices will be calculated for the adult, child, and infant. If a chronic hazard index exceeds

one, the potential for acute health effects will also be determined, by comparing the contaminant doses to available or derived short-term toxicity values.

3.5.1.2 Carcinogenic Risk

The carcinogenic risk posed by each contaminant through each exposure route will be calculated using the following equation:

$$\text{Cancer Risk} = \text{Contaminant Dose (mg/kg/day)} \times \text{Carcinogenic Potency Factor (mg/kg/day)}^{-1} \times \text{Exposure Duration Adjustment}$$

The exposure duration adjustment takes into account the length of exposure, in effect averaging the calculated daily contaminant dose over a 70-year lifetime. The total risk posed by each contaminant will be calculated by adding the risks posed by the contaminant through all exposure routes. The lifetime incremental cancer risk posed by all contaminants will be estimated by summing the risks posed by all contaminants through all exposure routes.

3.5.2 Uncertainty Analysis

All key assumptions and uncertainties and their potential effects on the risk estimates presented in the risk characterization will be summarized. A quantitative sensitivity analysis will be performed for some of the assumptions that are indicated to have the greatest impact on the calculation of total risk.

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APPENDIX A

PRELIMINARY DATA AND SUPPORTING DOCUMENTATION FOR HEALTH RISK ASSESSMENT PROTOCOL

APPENDIX A

PRELIMINARY DATA AND SUPPORTING DOCUMENTATION
FOR HEALTH RISK ASSESSMENT PROTOCOL

TABLE 1. **EMISSION RATES FOR ROCKY MOUNTAIN ARSENAL BASIN F WASTE SUBMERGED QUENCH INCINERATOR**

Category/ Pollutant	Base Case (a) (ton/yr)	Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)	Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Dioxins/Furans						
U.S. EPA TEF	4.16E-09	1.19E-09	1.50E-10	6.63E-08	1.90E-08	2.39E-09
Metals						
Aluminum	1.80E-02	5.15E-03	6.49E-04	2.50E-02	7.14E-03	8.99E-04
Antimony	6.34E-04	1.81E-04	2.28E-05	1.08E-01	3.10E-02	3.90E-03
Arsenic	3.59E-03	1.03E-03	1.29E-04	8.67E-03	2.48E-03	3.12E-04
Barium	8.79E-04	2.51E-04	3.16E-05	1.83E+01	5.24E+00	6.60E-01
Beryllium	3.66E-05	1.05E-05	1.32E-06	1.53E-03	4.37E-04	5.50E-05
Boron	2.68E-02	7.65E-03	9.63E-04	3.63E-02	1.04E-02	1.31E-03
Cadmium	1.04E-04	2.98E-05	3.76E-06	2.03E-03	5.79E-04	7.30E-05
Calcium	1.54E-01	4.39E-02	5.53E-03	2.93E-01	8.36E-02	1.05E-02
Chromium	2.47E-04	7.05E-05	8.88E-06	3.32E-04	9.49E-05	1.20E-05
Cobalt	7.89E-04	2.25E-04	2.84E-05	8.13E-04	2.32E-04	2.93E-05
Copper	3.35E+00	9.59E-01	1.21E-01	6.35E+00	1.82E+00	2.29E-01
Iron	4.77E-02	1.36E-02	1.72E-03	8.13E-02	2.32E-02	2.93E-03
Lead	1.12E-03	3.21E-04	4.05E-05	3.33E-02	9.52E-03	1.20E-03
Lithium	1.10E-04	3.14E-05	3.96E-06	2.07E-04	5.92E-05	7.45E-06
Magnesium	1.43E-01	4.08E-02	5.14E-03	2.39E-01	6.81E-02	8.59E-03
Manganese	6.16E-03	1.76E-03	2.22E-04	6.93E-03	1.98E-03	2.50E-04
Mercury	9.93E-04	2.84E-04	3.57E-05	1.08E-01	3.10E-02	3.90E-03
Molybdenum	1.10E-02	3.15E-03	3.97E-04	1.14E-02	3.25E-03	4.09E-04
Nickel	2.86E-02	8.18E-03	1.03E-03	2.97E-02	8.49E-03	1.07E-03
Potassium	1.14E+00	3.25E-01	4.09E-02	2.54E+00	7.24E-01	9.13E-02
Selenium	9.20E+00	2.63E+00	3.31E-01	9.20E+00	2.63E+00	3.31E-01
Silicon	1.58E-01	4.52E-02	5.70E-03	1.89E-01	5.41E-02	6.81E-03
Silver	9.52E-02	2.72E-02	3.43E-03	1.08E+00	3.10E-01	3.90E-02
Sodium	1.17E+02	3.34E+01	4.21E+00	5.56E+02	1.59E+02	2.00E+01
Strontium	3.66E-05	1.05E-05	1.32E-06	5.66E-05	1.62E-05	2.04E-06
Thallium	9.25E-03	2.64E-03	3.33E-04	1.08E-01	3.10E-02	3.90E-03
Tin	8.09E-03	2.31E-03	2.91E-04	8.79E-03	2.51E-03	3.16E-04
Titanium	6.10E-05	1.74E-05	2.20E-06	1.07E-04	3.07E-05	3.87E-06
Vanadium	2.34E-03	6.68E-04	8.42E-05	2.62E-03	7.49E-04	9.44E-05
Yittrium	NA	NA	NA	2.14E-05	6.11E-06	7.70E-07
Zinc	1.63E-02	4.65E-03	5.86E-04	3.34E-02	9.54E-03	1.20E-03
Organics						
1,1-Dichloroethene	3.81E-11	1.09E-11	1.37E-12			
1,2-Dichloroethene	2.65E-11	7.57E-12	9.53E-13			
1,2-Dichloropropane	3.07E-12	8.77E-13	1.11E-13			
1,3-Dimethylbenzene	2.72E-08	7.77E-09	9.79E-10			
Acetone	1.07E-11	3.07E-12	3.87E-13			
Ammonia	3.26E-03	9.32E-04	1.17E-04			
Benzene	1.40E-07	3.99E-08	5.03E-09			
Bromomethane	1.36E-08	3.89E-09	4.90E-10			
Carbon Tetrachloride	4.34E-11	1.24E-11	1.56E-12			
Chlorobenzene	3.37E-08	9.62E-09	1.21E-09			
Chloroform	6.87E-12	1.96E-12	2.47E-13			
Ethylbenzene	4.08E-08	1.17E-08	1.47E-09			
Methanol	1.63E-07	4.65E-08	5.86E-09			
Methylene Chloride	1.36E-08	3.89E-09	4.90E-10			
Tetrachlorethene	5.43E-10	1.55E-10	1.95E-11			
Toluene	6.80E-08	1.94E-08	2.45E-09			
Trichloroethene	8.33E-11	2.38E-11	3.00E-12			
Xylene	2.72E-08	7.77E-09	9.79E-10			
4-Chlorophenylmethylsulfone	2.52E-11	7.21E-12	9.08E-13			
4-Chlorophenylmethylsulfoxide	9.40E-11	2.69E-11	3.38E-12			
4-Nitrophenol	5.76E-11	1.64E-11	2.07E-12			
Aldrin	6.91E-12	1.97E-12	2.49E-13			
Atrazine	1.54E-12	4.39E-13	5.53E-14			

TABLE 1 (con'd). **EMISSION RATES FOR ROCKY MOUNTAIN ARSENAL BASIN F WASTE SUBMERGED QUENCH INCINERATOR**

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Organics						
Hydrogen Cyanide	6.46E-08	1.85E-08	2.32E-09			
Dieldrin	1.42E-12	4.06E-13	5.11E-14			
Diisopropyl Methylphosphonate	2.49E-10	7.13E-11	8.98E-12			
Dimethyl Methylphosphonate	5.95E-09	1.70E-09	2.14E-10			
Dimethyldisulfide	6.91E-10	1.97E-10	2.49E-11			
Dimethylphosphate	1.63E-09	4.66E-10	5.87E-11			
Dithiane	2.49E-13	7.13E-14	8.98E-15			
Endrin	1.38E-12	3.95E-13	4.97E-14			
Hexachlorocyclopentadiene	1.28E-11	3.67E-12	4.63E-13			
Isodrin	3.64E-12	1.04E-12	1.31E-13			
Malathion	5.56E-12	1.59E-12	2.00E-13			
Parathion	7.68E-13	2.19E-13	2.76E-14			
Supona	2.30E-12	6.58E-13	8.29E-14			
Urea	9.98E-07	2.85E-07	3.59E-08			
Vapona	6.14E-12	1.75E-12	2.21E-13			
p,p-DDE	1.15E-08	3.29E-09	4.14E-10			
p,p-DDT	2.30E-12	6.58E-13	8.29E-14			
PICs w/ Specific Precursors						
Vinyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Methyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Styrene	1.36E-07	3.90E-08	4.91E-09			
Phenol	7.37E-07	2.11E-07	2.65E-08			
Benzaldehyde	1.42E-07	4.05E-08	5.10E-09			
Benzoic Acid	6.86E-08	1.96E-08	2.47E-09			
Acetonitrile	6.52E-10	1.86E-10	2.35E-11			
Acrylonitrile	6.52E-11	1.86E-11	2.35E-12			
Cyanogen	6.52E-12	1.86E-12	2.35E-13			
Hexachlorobenzene	4.64E-10	1.32E-10	1.67E-11			
Pentachlorobenzene	2.07E-10	5.93E-11	7.47E-12			
Tetrachlorobenzene	8.75E-11	2.50E-11	3.15E-12			
Trichlorobenzene	4.62E-11	1.32E-11	1.66E-12			
Dichlorobenzene	2.45E-11	6.99E-12	8.81E-13			
Biphenyl	6.82E-08	1.95E-08	2.45E-09			
4-Chlorobiphenyl	7.88E-08	2.25E-08	2.84E-09			
4,4-Chlorobiphenyl	1.03E-09	2.95E-10	3.72E-11			
Benzonitrile	6.52E-11	1.86E-11	2.35E-12			
Pyridine	6.52E-12	1.86E-12	2.35E-13			
Carbazole	1.30E-11	3.73E-12	4.70E-13			
Quinoline	3.26E-11	9.32E-12	1.17E-12			
PICs w/ Specific Precursors						
Benzofuran	2.72E-07	7.77E-08	9.79E-09			
Dibenzofuran	1.36E-08	3.88E-09	4.89E-10			
Acenaphthalene	6.80E-08	1.94E-08	2.45E-09			
Acenaphthene	6.80E-08	1.94E-08	2.45E-09			
Fluoranthene	4.08E-08	1.17E-08	1.47E-09			
Phenanthrene	2.72E-08	7.77E-09	9.79E-10			
Pyrene	1.36E-08	3.88E-09	4.89E-10			
Fluorene	1.36E-08	3.88E-09	4.89E-10			
Benzo(a)pyrene	1.36E-08	3.88E-09	4.89E-10			
Dibenzo(a)anthracene	1.36E-08	3.88E-09	4.89E-10			
Chrysene	1.36E-08	3.88E-09	4.89E-10			

TABLE 1 (con'd). **EMISSION RATES FOR ROCKY MOUNTAIN ARSENAL BASIN F WASTE SUBMERGED QUENCH INCINERATOR**

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Acid Gases & Other Compounds						
Particulate Matter	14.00	4.00	0.50	14.00	4.00	0.50
Carbon Monoxide	4.71	1.35	0.17	7.29	2.08	0.26
Hydrogen Chloride	4.73	1.35	0.17	14.00	4.00	0.50
Hydrogen Fluoride	0.17	0.049	0.006	0.32	0.092	0.012
Nitric Acid	3.85	1.10	0.14	3.85	1.10	0.14
Nitrogen Dioxide	32.13	9.18	1.16	143.22	40.92	5.16
Phosphate	3.44	0.98	0.12	15.04	4.30	0.54
Sulfuric Acid	10.40	2.97	0.37	17.34	4.96	0.62
Sulfur Dioxide	24.43	6.98	0.88	101.50	29.00	3.65

(a) These estimates are based upon the acceptable results during the test burn for dioxins/furans and the maximum of the acceptable test results or the maximum of the averages waste stream data. The organics emissions are based upon Dellinger's analysis of the maximum of the averages wastestream data.

(b) For metals: based upon the maximum value of the test results from the test burn, the maximum of the maximum values from the wastestream data, and the EPA Guidance Tier II limits for complex terrain.

For dioxins/furans: based upon the 95% confidence interval from WESTON's hazardous waste incinerator emissions database.

TABLE 2.

EXPECTED ACID & OTHER COMPOUNDS EMISSIONS BASED ON TEST BURN EMISSIONS & WASTE STREAM DATA

Original Pollutant	Based on Waste Stream Data: Waste Feedrate (1) (lb/ton)	Converted Pollutant	Uncontrolled Emissions (2) (lb/ton)	Removal Efficiency (%)	Controlled Emissions (3) (lb/ton)	Based upon Acceptable Test Burn Data: Controlled Emissions (4) (lb/ton)	Maximum Emissions Between the Two Scenarios (5) (lb/ton)	(lb/hr)
Particulate Matter (PM)	NA	PM	NA	NA	NA	NA	NA	4.00 (6)
Carbon Monoxide (CO)	NA	CO	NA	NA	NA	0.261	0.261	1.35
Chloride (Cl)	215.5	HCl	221.7	95	11.1	NA	NA	1.35 (8)
Fluoride (F)	0.18	HF	0.2	95	0.009	NA	0.009	0.05
Nitrate (NO3)	2.1	HNO3	2.1	90	0.213	NA	0.213	1.10
Nitrogen (N)	110.5	NO2	362.9	0	362.9	1.778	1.778	9.18
Phosphorus (P)	31.7	PO4	31.7	99.4	0.190	0.098	0.190	0.98
Sulfate (SO4)	56.4	H2SO4	57.6	99	0.6	NA	0.58	2.97
Sulfur (S)	NA	SO2	NA	90	NA	NA	NA	6.98 (8)

MAXIMUM ACID & OTHER COMPOUNDS EMISSIONS BASED ON TEST BURN EMISSIONS & WASTE STREAM DATA

Original Pollutant	Based on Waste Stream Data: Waste Feedrate (1) (lb/ton)	Converted Pollutant	Uncontrolled Emissions (2) (lb/ton)	Removal Efficiency (%)	Controlled Emissions (3) (lb/ton)	Based upon Test Burn Data: Controlled Emissions (4) (lb/ton)	Maximum Emissions Between the Two Scenarios (5) (lb/ton)	(lb/hr)
Particulate Matter (PM)	NA	PM	NA	NA	NA	NA	NA	4.00 (6)
Carbon Monoxide (CO)	NA	CO	NA	NA	NA	0.403 (7)	0.403	2.08
Chloride (Cl)	318.0	HCl	327.1	95	16.4	NA	NA	4.00 (9)
Fluoride (F)	0.34	HF	0.4	95	0.018	NA	0.018	0.09
Nitrate (NO3)	2.1	HNO3	2.1	90	0.213	NA	0.213	1.10
Nitrogen (N)	168.4	NO2	553.0	0	553.0	NA	NA	40.92 (9)
Phosphorus (P)	138.7	PO4	138.7	99.4	0.832	0.038	0.832	4.30
Sulfate (SO4)	94.0	H2SO4	96.0	99	1.0	NA	0.96	4.96
Sulfur (S)	NA	SO2	NA	90	NA	NA	NA	29.00 (9)

(1) Based upon the maximum of the maximums emission concentration from historical test data (tons/yr) and multiplying by 2000 lbs/ton / ((10,325 lbs of waste/hr / 2000 lbs/ton) x 7,000 operating hrs/yr).
(2) Based upon the waste feed rate x the molecular weight of the converted pollutant the molecular weight of the orginal pollutant.
(3) Controlled Emissions = Uncontrolled Emissions x (1- % Removal Efficiency)
(4) Based upon the average emission during the test burn by T-Thermal in Aug. 1990.
(5) The maximum values were used for all pollutants, except NO2, for which the test burn data was used.
(6) Particulate is based upon Colorado regulations of 0.08 gr/dscf @ 12% CO2.
(7) Carbon monoxide is based upon Federal regulations of 100 ppm.
(8) Based upon February 1989 test burn which tested for the specific compounds.
(9) Based upon vendor performance guarentees.

TABLE 3

Chemicals of Concern Evaluated[1] in Tier 1 Surface Water Screening Analysis For Rocky Mountain Arsenal

03-Dec-90
02:46:14 PM

POLLUTANTS	EMISSION RATE (g/sec)	TOTAL DEPOSITION RATE (g/m2*yr)	TOTAL BASIN DEPOSITION (g/yr)	WATER CONCENTRATION (mg/l)	AWQCs FISH INGESTION (mg/l)
ORGANICS					
Fluoranthene	1.91E-09	1.72E-12	2.23E-07	3.23E-13	5.40E-02
Pentachlorobenzene	9.73E-12	8.76E-15	1.13E-09	1.64E-15	8.50E-02
Tetrachlorobenzene	4.11E-12	3.70E-15	4.79E-10	6.93E-16	4.80E-02
INORGANICS					
Antimony	3.90E-03	3.51E-06	4.55E-01	6.58E-07	4.50E+01
Chromium (III)	1.20E-05	1.08E-08	1.40E-03	2.02E-09	3.43E+03
Manganese	2.50E-04	2.25E-07	2.91E-02	4.22E-08	1.00E-01
Mercury	3.90E-03	3.51E-06	4.55E-01	6.58E-07	1.46E-04
Nickel	1.07E-03	9.63E-07	1.25E-01	1.81E-07	1.00E-01
Thallium	3.90E-03	3.51E-06	4.55E-01	6.58E-07	4.80E-02

9.00E-04 Total deposition factor (g/m2*yr)/(g/sec)
1.30E+05 Total basin area (m2)
5.00E-01 Hydraulic residence time (yr)
3.45E+05 Lake volume (m3)
1.00E-03 Conversion factor (m3/l)
1.00E+03 Conversion factor (mg/g)

TDR = ER*TDF
TBD = TDR*TBA
Cwater = TBD*HRT*CF*CF/VOL

[1] All chemicals evaluated in this analysis will be excluded from the surface water pathway in the risk assessment.

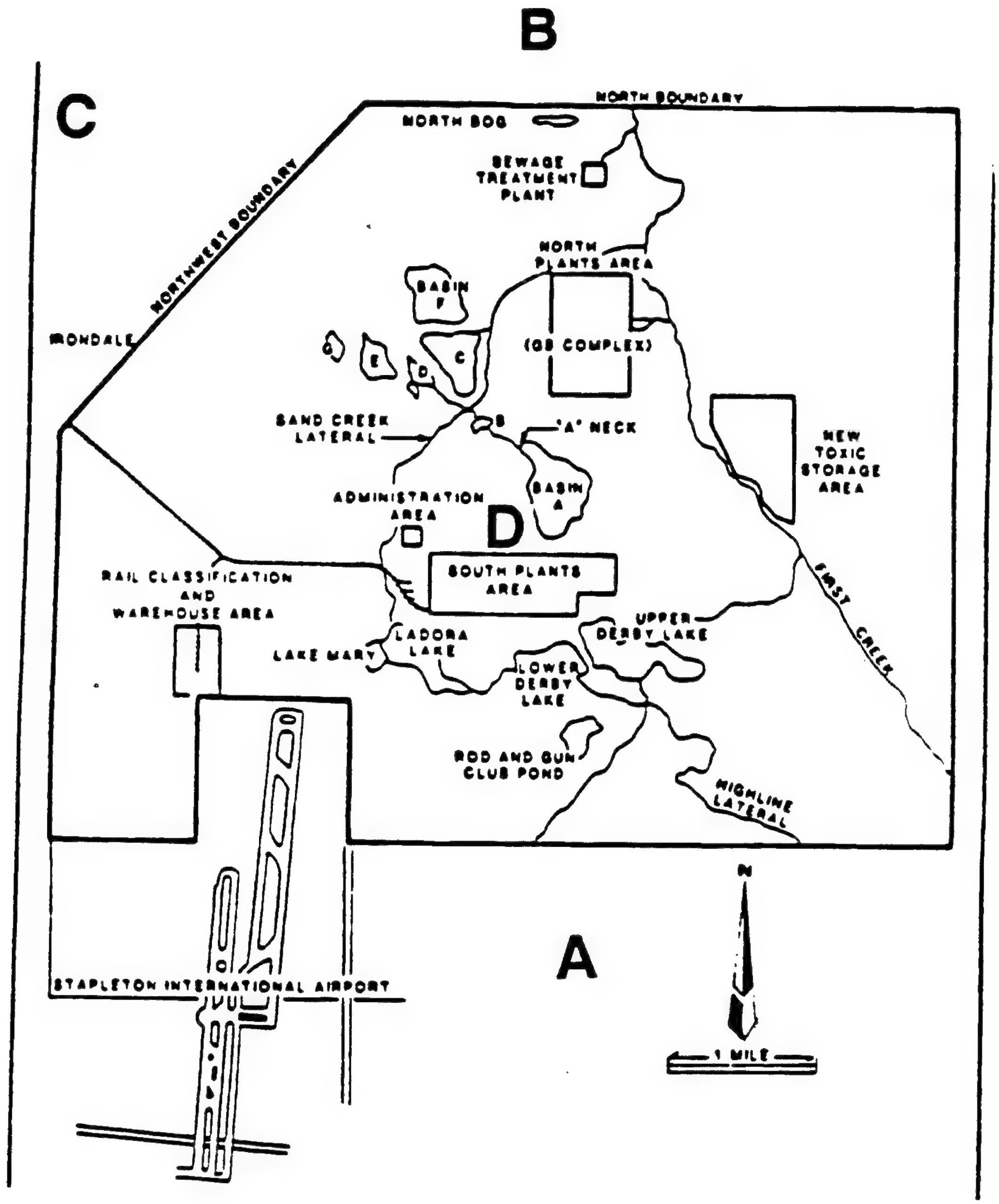

FIGURE 1. Locations of Reasonable, Maximally-Exposed Individuals Based Upon Ambient Air and Deposition Modeling Data.

(A) Area of maximum total deposition (residential); (B) Area of maximum dry deposition and maximum ambient groundlevel air concentration (residential); (C) Area of maximum total deposition for local cattle farm; (D) A maintenance worker on-site exposed to area weighted total deposition and ambient groundlevel air concentrations.

TABLE 4A

Rocky Mountain Arsenal (RMA)
Slope Factors for
Carcinogenic Health Effects
(mg/kg/day^-1)

Pollutant	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification	Inhalation Route Slope Factor	Reference or Basis of Inhalation Slope Factor	Oral Route Slope Factor	Reference or Basis of Oral Slope Factor	Dermal Route Slope Factor
Organics							
Acrylonitrile	B1	2A	2.40E-01	IRIS, 1990	5.40E-01	IRIS, 1990	NC
Aldrin	B2	3	1.70E+01	IRIS, 1990	1.70E+01	IRIS, 1990	3.40E+01
Benzene	A	1	2.90E-02	IRIS, 1990	2.90E-02	IRIS, 1990	NC
Carbazole	B2	3	2.00E-02	OSF	2.00E-02	EBASCO, 1990	4.00E-02
Carbon Tetrachloride	B2	2B	1.30E-01	IRIS, 1990	1.30E-01	IRIS, 1990	NC
Chloroform	B2	2B	8.10E-02	IRIS, 1990	6.10E-03	IRIS, 1990	NC
DDE	B2		3.40E-01	OSF	3.40E-01	IRIS, 1990	6.80E-01
DDT	B2	2B	3.40E-01	IRIS, 1990	3.40E-01	IRIS, 1990	6.80E-01
1,4-Dichlorobenzene	B2	2B	2.40E-02	ORD EPA, 1990	2.40E-02	EPA, 1990	NC
1,1-Dichloroethene	C		1.20E+00	IRIS, 1990	6.00E-01	IRIS, 1990	NC
1,2-Dichloropropane	B2	3	6.80E-02	ORD EPA, 1990	6.80E-02	EPA, 1990	NC
Dieldrin	B2	3	1.60E+01	IRIS, 1990	1.60E+01	IRIS, 1990	3.20E+01
Dioxins/Furans (as 2,3,7,8 TCDD)	B2	2B	1.13E+05	EPA, 1990	1.50E+05	EPA, 1990	3.00E+05
Hexachlorobenzene	B2	2B	1.60E+00	EPA, 1990	1.60E+00	EPA, 1990	3.20E+00
Methyl Chloride	C	3	6.30E-03	EPA, 1990	1.30E-02	EPA, 1990	NC
Methylene Chloride	B2		1.40E-02	EPA, 1990	7.50E-03	EPA, 1990	NC
PAHs	—	—	—	—	—	—	—
Benzo(a)pyrene	B2	2A	6.10E+00	EPA, 1986	1.15E+01	EPA, 1986	2.30E+01
Chrysene	B2	3	6.10E+00	EPA, 1986	1.15E+01	EPA, 1986	2.30E+01
Dibenzo(a)anthracene		2A,3	6.10E+00	EPA, 1986	1.15E+01	EPA, 1986	2.30E+01
Parathion	C						
Quinoline	C		1.20E+01	ORD	1.20E+01	EPA, 1990	2.40E+01
Styrene	B2	2B	2.[illegible]E-03	EPA, 1990	3.00E-02	EPA, 1990	NC
Tetrachloroethene	B2				5.10E-02	EPA, 1990	NC
Trichloroethene	B2	3	1.10E-02	EPA, 1990	1.10E-02	EPA, 1990	NC
Vapona	B2	3	2.90E-01	ORD	2.90E-01	IRIS, 1990	5.80E-01
Vinyl Chloride	A	1	2.95E-01	EPA, 1990	2.30E+00	EPA, 1990	NC

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TABLE 4A (continued)

Rocky Mountain Arsenal (RMA)
Slope Factors for
Carcinogenic Health Effects
(mg/kg/day^-1)

Pollutant	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification	Inhalation Route Slope Factor	Reference or Basis of Inhalation Slope Factor	Oral Route Slope Factor	Reference or Basis of Oral Slope Factor	Dermal Route Slope Factor
Inorganics							
Arsenic	A	1	1.50E+01	IRIS, 1990	1.75E+00	EPA, 1990	3.50E+01
Beryllium	B2		8.40E+00	IRIS, 1990	4.30E+00	IRIS, 1990	8.60E+01
Cadmium	B1	2A	6.10E+00	IRIS, 1990	NC	—	NC
Chromium (VI)	A	1	4.10E+01	IRIS, 1990	NC	—	NC
Lead	B2	2B					
Nickel (as soluble salts)	A	1	2.00E-02	IRIS, 1990	NC	—	NC

NC = Not of concern

NE = Not evaluated

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TABLE 4B

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for
Noncarcinogenic Health Effects
(mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Organics					
Acetone	1.82E+00	ACGIH-TWA	1.00E-01	EPA, 1990	NC
Acetonitrile	1.00E-02	EPA,1990	6.00E-02	EPA, 1990	3.00E-02
Acrylonitrile	4.39E-03	ACGIH-TWA	2.70E-04	Derived	NC
Aldrin	2.55E-04	ACGIH-TWA	3.00E-05	IRIS, 1990	1.50E-05
Atrazine	5.10E-03	ACGIH-TWA	5.00E-03	IRIS, 1990	2.50E-03
Benzaldehyde	1.00E-01	Oral RfD	1.00E-01	IRIS, 1990	5.00E-02
Benzene	3.26E-02	ACGIH-TWA	1.00E-03	Derived	NC
Benzofuran	5.00E-03	Oral RfD	5.00E-03	Derived	2.50E-03
Benzoic Acid	4.00E+00	Oral RfD	4.00E+00	IRIS, 1990	2.00E+00
Benzonitrile	8.00E-03	Oral RfD	8.00E-03	Derived	4.00E-03
Biphenyl	1.33E-03	ACGIH-TWA	5.00E-02	EPA, 1990	NC
Bromomethane	1.71E-02	EPA, 1990	1.40E-03	IRIS, 1990	NC
Carbazole	5.00E-03	Oral RfD	5.00E-03	Derived	2.50E-03
Carbon Tetrachloride	3.16E-02	ACGIH-TWA	7.00E-04	IRIS, 1990	NC
Chlorobenzene	5.00E-03	EPA, 1990	2.00E-02	IRIS, 1990	NC
4-Chlorobiphenyl	2.45E-02	Oral RfD	2.45E-02	Derived	1.22E-02
4,4'-Chlorobiphenyl	2.33E-02	Oral RfD	2.33E-02	Derived	1.16E-02
Chloroform	5.00E-02	ACGIH-TWA	1.00E-02	IRIS, 1990	NC
4-Chlorophenylmethylsulfone	1.98E-02	Oral RfD	1.98E-02	EBASCO, 1990	9.90E-03
4-Chlorophenylmethylsulfoxide	1.98E-02	Oral RfD	1.98E-02	EBASCO, 1990	9.90E-03
DDE	5.00E-04	Oral RfD	5.00E-04	IRIS, 1990	2.50E-04
DDT	1.02E-03	ACGIH-TWA	5.00E-04	IRIS, 1990	2.50E-04
Dibenzofuran					
Dichlorobenzene	4.00E-02	EPA, 1990	9.00E-02	EPA, 1990	NC
1,4-Dichlorobenzene					
1,1-Dichloroethene	2.04E-02	ACGIH-TWA	9.00E-02	EPA, 1990	NC
1,2-Dichloroethene(total)	2.00E-02	Oral RfD	9.00E-03	IRIS, 1990	NC
1,2-Dichloropropane	3.54E-01	ACGIH-TWA	2.00E-02	IRIS, 1990	NC

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TABLE 4B (continued)

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for
Noncarcinogenic Health Effects
(mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Dieldrin	2.55E-04	ACGIH-TWA	5.00E-05	IRIS, 1990	2.50E-05
Diisopropyl Methylphosphonate	8.00E-02	Oral RfD	8.00E-02	IRIS, 1990	4.00E-02
1,3-Dimethylbenzene	2.00E-01	EPA, 1990	5.00E-02	Derived	2.50E-02
Dimethyldisulfide	8.10E-03	Oral RfD	8.10E-03	EBASCO, 1990	NC
Dimethyl Methylphosphonate	1.80E-02	Oral RfD	1.80E-02	EBASCO, 1990	9.00E-03
Dimethylphosphate	8.71E-02	Oral RfD	8.71E-02	Derived	4.36E-02
Dioxins/Furans (as 2,3,7,8 TCDD)	1.00E-09	Oral RfD	1.00E-09	ATSDR, 1989	5.00E-10
Dithiane	1.00E-02	Oral RfD	1.00E-02	EBASCO, 1990	5.00E-03
Endrin	1.02E-04	ACGIH-TWA	3.00E-04	IRIS, 1990	1.50E-04
Ethylbenzene	4.43E-01	ACGIH-TWA	1.00E-01	IRIS, 1990	NC
Hexachlorobenzene	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04
Hexachlorocyclopentadiene (HCCPD)	2.00E-05	EPA, 1990	7.00E-03	IRIS, 1990	3.50E-03
Isodrin	7.00E-05	Oral RfD	7.00E-05	EBASCO, 1990	3.50E-05
Malathion	1.02E-02	ACGIH-TWA	2.00E-02	IRIS, 1990	1.00E-02
Methanol	2.67E-01	ACGIH-TWA	5.00E-01	IRIS, 1990	2.50E-01
Methyl Chloride	1.05E-01	ACGIH-TWA	1.80E-02	Derived	NC
Methylene Chloride	8.57E-01	EPA, 1990	6.00E-02	EPA, 1990	NC
4-Nitrophenol	2.50E-03	Oral RfD	2.50E-03	Derived	1.25E-03
PAHs	–	–	–	–	–
Acenaphthalene	6.00E-02	Oral RfD	6.00E-02	IRIS, 1990	3.00E-02
Acenaphthene	6.00E-02	Oral RfD	6.00E-02	EPA, 1990	3.00E-02
Benzo[a]pyrene	3.00E-02	Oral RfD	3.00E-02	IRIS, 1990	1.50E-02
Chrysene	3.00E-02	Oral RfD	3.00E-02	IRIS, 1990	1.50E-02
Dibenzo[a]anthracene	3.00E-02	Oral RfD	3.00E-02	IRIS, 1990	1.50E-02
Fluoranthene	4.00E-02	Oral RfD	4.00E-02	EPA, 1990	2.00E-02
Fluorene	4.00E-02	Oral RfD	4.00E-02	IRIS, 1990	2.00E-02
Phenanthrene	3.00E-02	Oral RfD	3.00E-02	EPA, 1990	1.50E-02
Pyrene	3.00E-02	Oral RfD	3.00E-02	IRIS, 1990	1.50E-02
Parathion	5.10E-05	REL	6.00E-03	EPA, 1990	3.00E-03
Pentachlorobenzene	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04

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TABLE 4B (continued)

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for
Noncarcinogenic Health Effects
(mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Phenol	1.94E-02	ACGIH-TWA	6.00E-01	IRIS, 1990	3.00E-01
Pyridine	1.63E-02	ACGIH-TWA	1.00E-03	IRIS, 1990	NC
Quinoline	2.00E-01	Oral RfD	2.00E-01	IRIS, 1990	1.00E-01
Styrene	2.17E-01	ACGIH-TWA	2.00E-01	IRIS, 1990	NC
Supona	1.50E-04	Oral RfD	1.50E-04	EBASCO, 1990	7.50E-05
Tetrachlorobenzene	3.00E-04	Oral RfD	3.00E-04	IRIS, 1990	1.50E-04
Tetrachloroethene	3.46E-01	ACGIH-TWA	1.00E-02	IRIS, 1990	NC
Toluene	5.71E-01	EPA, 1990	2.00E-01	IRIS, 1990	NC
Trichlorobenzene	3.00E-03	EPA, 1990	2.00E-02	EPA, 1990	1.00E-02
Trichloroethene	2.74E-01	ACGIH-TWA	7.35E-03	EPA, 1987	NC
Urea	8.47E-02	Oral RfD	8.47E-02	Derived	4.28E-02
Vapona	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04
Vinyl Chloride	1.33E-02	ACGIH-TWA	1.30E-03	Derived	NC
Xylenes (total)	8.57E-02	EPA, 1990	2.00E+00	EPA, 1990	NC
Inorganics					
Aluminum	2.04E-03	ACGIH-TWA	NE	–	NC
Ammonia	1.73E-02	ACGIH-TWA	NE	–	NC
Antimony	5.10E-04	ACGIH-TWA	4.00E-04	IRIS, 1990	2.00E-05
Arsenic	2.04E-04	ACGIH-TWA	1.00E-03	EPA, 1990	5.00E-05
Barium	1.00E-04	EPA, 1990	7.00E-02	IRIS, 1990	3.50E-03
Beryllium	2.04E-06	ACGIH-TWA	5.00E-03	IRIS, 1990	2.50E-04
Boron	4.11E-03	ACGIH-TWA	NE	–	NC
Cadmium	5.10E-05	ACGIH-TWA	1.00E-03	IRIS, 1990	NC
Calcium	1.46E-03	ACGIH-TWA	NC	–	NC
Chromium (III)	5.10E-04	ACGIH-TWA	NE	–	NC
Chromium (VI)	5.10E-05	ACGIH-TWA	5.00E-03	IRIS, 1990	NC
Cobalt	5.10E-05	ACGIH-TWA	2.30E-03	Derived	NC

TABLE 4B (continued)

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for
Noncarcinogenic Health Effects
(mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Copper	1.00E-02	EBASCO, 1990	3.80E-02	EBASCO, 1990	1.90E-03
Cyanogen	2.14E-02	ACGIH-TWA	NE	–	NC
Hydrogen Cyanide	5.10E-03	ACGIH-TWA	NE	–	NC
Iron	1.02E-03	ACGIH-TWA	NE	–	NC
Lead	4.30E-04	EBASCO, 1990	1.40E-03	EBASCO, 1990	7.00E-05
Lithium	1.00E-04	Derived	NE	–	NC
Magnesium	6.15E-03	ACGIH-TWA	NE	–	NC
Manganese	3.00E-04	EPA, 1990	NE	–	NC
Mercury	8.57E-05	EPA, 1990	3.00E-04	EPA, 1990	1.50E-05
Molybdenum	5.10E-03	ACGIH-TWA	NE	–	NC
Nickel	1.02E-04	ACGIH-TWA	NE	–	NC
Phosphate			NC	–	NC
Potassium			NC	–	NC
Selenium	2.04E-04	ACGIH-TWA	3.00E-03	EPA, 1990	1.50E-04
Silicon	5.10E-05	ACGIH-TWA	NC	–	NC
Silver	1.02E-05	ACGIH-TWA	3.00E-03	IRIS, 1990	1.50E-04
Sodium			NC	–	NC
Strontium			NE	–	NC
Thallium	1.02E-04	ACGIH-TWA	7.00E-05	EPA, 1990	3.50E-06
Tin	2.04E-03	ACGIH-TWA	NE	–	NC
Titanium	6.11E-03	ACGIH-TWA	NE	–	NC
Vanadium	5.10E-05	ACGIH-TWA	7.00E-03	EPA, 1990	NC
Yttrium	1.02E-03	ACGIH-TWA	NE	–	NC
Zinc	8.19E-03	ACGIH-TWA	2.00E-01	EPA, 1990	NC

TABLE 4B (continued)

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for
Noncarcinogenic Health Effects
(mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Other Acid Gases/ Criteria Pollutants					
Carbon Monoxide	5.81E-02	ACGIH-TWA			
Hydrogen Chloride	7.65E-03	ACGIH-TWA			
Hydrogen Fluoride	2.65E-03	ACGIH-TWA			
Nitric Acid	5.30E-03	ACGIH-TWA			
Nitrogen Oxides	2.86E-02	NAAQS			
Particulate Matter	4.29E-02	NAAQS			
Sulfur Dioxide	2.29E-02	NAAQS			

NC = Not of concern

NE = Not Evaluated

TABLE 5. Exposure Parameters* to be Used in Human Health Risk Assessment - Rocky Mountain Arsenal

Pathways and Parameters	Maintenance Worker	Farm Household-Adult	Farm Household-Child	Resident - Adult	Resident - Child
AIR PATHWAY					
• Breathing rate	10 m^3/day (EBASCO)	20 m^3/day (Woodward Clyde)	10 m^3/day	20 m^3/day (Woodward Clyde)	10 m^3/day
• Exposure frequency	250 days/yr[a]	365 days/yr	365 days/yr	365 days/yr	365 days/yr
SOIL PATHWAY					
• Soil ingestion rate	50 mg/day (EBASCO)	100 mg/day (EPA, Region VIII)	200 mg/day (EPA, Region VIII)	100 mg/day (EPA, Region VIII)	200 mg/day (EPA, Region VIII)
• Exposure frequency for soil ingestion	225 days/yr[a]	365 days/yr	365 days/yr	365 days/yr	365 days/yr
• Skin surface area	1700 cm^2 (EBASCO)	1700 cm^2 (EBASCO)	2188 cm^2 [b]	1700 cm^2 (EBASCO)	2188 cm^2 [b]
• Soil adherence factor	3.5 mg/cm^2 (EBASCO)	3.5 mg/cm^2 (EBASCO)	0.51 mg/cm^2 (EBASCO)	0.51 mg/cm^2 (EBASCO)	0.51 mg/cm^2 (EBASCO)
• Soil matrix factor	0.15 (EBASCO)	0.15 (EBASCO)	0.15 (EBASCO)	0.15 (EBASCO)	0.15 (EBASCO)

TABLE 5. Exposure Parameters* to be Used in Human Health Risk Assessment - Rocky Mountain Arsenal (cont'd.)

Pathways and Parameters	Maintenance Worker	Farm Household-Adult	Farm Household-Child	Resident - Adult	Resident - Child
SOIL PATHWAY					
• Dermal absorption factor	0.01 (metals) 0.10 (organics) (EBASCO)	0.01 (metals) 0.10 (organics) (EBASCO)	0.01 (metals) 0.10 (organics) (EBASCO)	0.01 (metals) 0.10 (organics) (EBASCO)	0.01 (metals) 0.10 (organics) (EBASCO)
• Exposure frequency for dermal contact	195 days/yr[c] (5 days/wk; 35 wks/yr)	195 days/yr[c]	195 days/yr[c]	117 days/yr[c] (3 days/wk; 35 wks/yr)	195 days/yr[c]
• Vegetable Ingestion rate[d]					
-Root	---	65.3 g/day (includes potatoes)	31.1 g/day (includes potatoes)	11.7 g/day (excludes potatoes)	3.88 g/day (excludes potatoes)
-Fruiting	---	64 g/day	33.6 g/day	64 g/day	33.6 g/day
-Leafy	---	11.9 g/day	1.24 g/day	11.9 g/day	1.24 g/day
• Percent Vegetables home-grown	---	90% (EPA, Region VIII)	90 % (EPA, Region VIII)	58% (HLA)	58% (HLA)
• Milk Ingestion Rate	---	305 g/day	390 g/day	305 g/day	390 g/day

TABLE 5. Exposure Parameters* to be Used in Human Health Risk Assessment - Rocky Mountain Arsenal (cont'd.)

Pathways and Parameters	Maintenance Worker	Farm Household-Adult	Farm Household-Child	Resident - Adult	Resident - Child
<u>SOIL PATHWAY</u>					
• Milk Fat ingestion rate	---	11 g/day	16 g/day	11 g/day	16 g/day
• Percent milk locally-produced	---	100%[e] (home-produced)	100%[e] (home-produced)	5%[f] (locally-obtained)	5%[f] (locally-obtained)
• Beef ingestion rate	---	67 g/day	37 g/day	67 g/day	37 g/day
• Beef fat ingestion rate	---	15 g/day	9 g/day	15 g/day	9 g/day
• Percent beef locally-produced	---	100%[e] (home-produced)	100%[e] (home-produced)	5%[f] (locally-obtained)	5%[f] (locally-obtained)
• Fish ingestion rate	---	4.84 g/day (HLA)	2.42 g/day (1/2 adult rate)	4.84 g/day (HLA)	2.42 g/day (1/2 adult rate)
<u>ALL PATHWAYS</u>					
• Body weight	70 kg (EBASCO)	70 kg (EBASCO)	15.5 kg (EBASCO)	70 kg (EBASCO)	15.5 kg (EBASCO)

*Infant Exposure Parameters: Inhalation rate = 3.8 m^3/day; Breast milk ingestion rate = 800 g/day; Body weight = 9 kg.

[a]Based on 90% of time spent outside (Don Marlow, personal communication, 1990).
[b]Based on arms and hands exposed 50% of the time, and arms, hands, and legs exposed 50% of the time (<u>Exposure Factors Handbook</u>, EPA/600/8-89/043, July, 1989).
[c]It was assumed that during the colder months, dermal exposure would be insignificant due to such factors as snow cover, frozen ground, and greatly reduced exposed skin surface area.
[d]All vegetable ingestion rates are expressed in wet weight and are cited from <u>Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions</u>. (EPA/600/6-90/003, 1990).
[e]It was assumed that a subsistence farmer would consume 100% home-produced beef and milk.
[f]We have conservatively assumed 5 percent of beef and milk intake for adult and child resident is from locally-produced sources.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

OCT 18 1990

Ref: 8HWM-FF

Donald Campbell
Office of the Program Manager
ATTN: AMXMR-PM
Rocky Mountain Arsenal
Commerce City, Colorado 80022-2180

Re: Rocky Mountain Arsenal (RMA), Basin F Liquid Incinerator, Comments on Air/Risk Assessment Protocol.

Dear Mr. Campbell:

In general we found that this document adequately addresses the Air Modeling and Risk Assessment for the Basin F incinerator.

The current lack of information regarding incinerator emission rate, incinerator efficiency, heat related transformation of Basin F liquid and photochemical reaction products virtually eliminates the ability to derive empirical data for input to the risk assessment process. As a result, no useful assessment of incinerator risk is possible at this time. No conclusions from this risk assessment can or should be drawn from the results of the proposed modeling effort or related risk assessment.

The approach presented will be (with the minor revisions as stated in attached Exhibits A and B) a useful tool for assessment of risk once empirical site-specific data is derived for the incinerator from the trial burn (see Decision Document, Section 9.2.2, page 9-5 thru 9-8).

Sincerely,

for Connally E. Mears
EPA Coordinator for RMA Cleanup

enclosure
cc: Glenn Tucker, ATSDR
Robert Williams, ATSDR
Bruce Huenefeld, RMA
Major Larry Rouse, DA
Brad Bridgewater, Department of Justice
David Shelton, CDH
Jeff Edson, CDH
Ellen Mangione, CDH
Vicky Peters, Colorado AG's Office
Robert O. Warwick, Weston
Lou Millitana, Weston
Chris Hahn, Shell Oil Company
George Roe, Shell Oil Company
all with enclosure

EXHIBIT A

Ambient Air Quality

GENERAL COMMENTS:

1. In general, we have found that this document adequately addresses the modeling of air quality in the vicinity of the incinerator. We feel that this model, along with the modifications that have been made by Weston, is an appropriate model for this application.

SPECIFIC COMMENTS:

Comment 1. Page 1-4, Table 1-1 Specify "all other compounds". Per the Decision Document (DD), a hazardous waste incinerator must achieve the RCRA substantive DRE of 99.99% for each principle organic hazardous constituent (POHC) designated for each waste feed. Include in the text that the trial burn is required to demonstrate the incinerator's ability to achieve the DD performance requirements.

Comment 2. Page 2-1, 2nd Paragraph Describe the "preliminary review" conducted to determine the area's classification. The area's classification should be based on the locations of the potential receptors. The west and south sides of the arsenal, where most to the sensitive receptors will most likely be located, are urban.

Give a description of the classification of Auer.

Comment 3. Page 2-1, 3rd Paragraph Note that channelling due to buildings or valleys can lead to higher concentrations than predicted by assuming flat terrain in the model. Again, a description of the geographical setting in the area is needed, as well as a consideration of the locations of the sensitive receptors in the area.

Comment 4. Page 2-2, 1st Paragraph List the Primary pollutants for which concentrations will be predicted.

Comment 5. Page 2-2, 3rd Paragraph The WESDEP allows for terrain adjustments. Will this be utilized for the area? The terrain adjustments should be used to more accurately predict the concentrations of pollutants to the south and west of the arsenal (i.e., Commerce City and Denver). Describe how the terrain adjustments are utilized in the WESDEP.

Comment 6. Page 2-4, 1st Paragraph Include in the text (here, or elsewhere) all included output of the WESDEP model (i.e., will output include meteorological data for specific day, highest and second highest concentration values, etc.).

Comment 7. Page 2-7, 2nd Paragraph What areas will be designated as sensitive receptors? What are the sensitive receptors in the area? Present a figure showing the receptor points for the area. Include the receptor points that will be located in sensitive areas. Show what each sensitive area represents.

Comment 8. The overall dispersion modeling protocol appears to be satisfactory. The use of EPA ISCST model for the inhalation concentrations follows EPA recommendations. The use of the WESTON WESTDEP model for wet and dry calculations is acceptable for risk assessment from Superfund/RCRA type analyses.

The use of National Weather Service (NWS) data (1985-1989) from Stapleton Airport is acceptable. The Proposed receptor grid, including a refined receptor grid with 100 meter resolution, is satisfactory. The modeling of wet deposition during precipitation events is correct. The plan to use different surface roughness lengths for each receptor should include calculation of surface roughness along the path from the stack to each receptor. The protocol did not address the issue of dispersion modeling and risk assessment for short term upset conditions. Malfunction upset conditions can produce high concentrations during a short time period.

EXHIBIT B

Health Risk Assessment Protocols

GENERAL COMMENTS:

1. The Risk Assessment Protocol is comprehensive with clearly stated objectives. The following specific comments apply primarily to issues needing further clarification.

SPECIFIC COMMENTS:

Comment 1. Page 3-1, Bullet 5 The risk assessment should not be concerned with the "technological feasibility of lowering (or raising) limits" for the proposed incinerator.

Comment 2. Page 3-2 We suggest that the DD should be consulted for reference concerning acceptable air concentrations (see page 9-1 thru 9-7).

Comment 3. Page 3-2 It is not clear why the authors have chosen to break out the assessment of acute health effects into its own section. Normally, acute, subchronic and chronic effects are dealt with in the toxicity and risk characterization sections of the risk assessment.

Comment 4. Page 3-3 Contaminant identification: "Historical data" which is intended for use in the risk assessment should be clearly defined and referenced. It seems that, although information regarding the waste stream might be useful supporting information, the central question is: what is the nature and rate of incinerator emissions?

Comment 5. Page 3-3 Contaminant Identification: Please provide references for the source of information regarding "anticipated destruction removal efficiencies (DRE)".

Comment 6. Page 3-3, first bullet What historical periods will be used to determine initial emissions data? Which parties will participate in finalizing exposure parameters and scenarios and when is that likely to occur? Guidance on this is contained in the DD, Section 9.

The term "hazard index" pertains to non-carcinogens.

Comment 7. Page 3-3 Consider a pathway that includes deposition of contaminants on leafy vegetables also.

We suggest that information developed in the Human Health Exposure Assessment should be used for applicable contaminants (already developed and checked).

Comment 8. Page 3-4, last paragraph, line 8 How will background levels be determined?

Comment 9. Page 3-4 Contaminant Identification: Please provide references for the source of information regarding "accepted theories of destruction and reformation".

Exactly how the relationship between toxicity and predicted emission rates will result in the selection of pollutants of concern is explained in the DD. A statement referencing this in the risk assessment protocol might be added for clarification.

Please explain the rationale for not assessing non-carcinogenic risk through the soil and surface water pathways. Please provide a brief description of the Tier 1 analysis for the reader.

Comment 10. Page 3-5, Section 3.3, second paragraph, line 3 Should read: "duration of toxic values" (?)

The Human Health Exposure Assessment (ExA) contains toxicity values for most chemicals likely to be of concern. We recommend that these be used rather than deriving new ones.

We commend the use of reasonable maximum exposure values. Make sure the values used in this deliverable are consistent with the RME values that were used in the Exposure Assessment (ExA) (see attached, Exhibit C) and those of Chris Weis, of this office, (ph. 303/294-7655), that were developed for the off-post RI.

Comment 11. Page 3-5 Toxicity Assessment: Contaminants or expected contaminants for which no numerical estimates of toxicity are available should be identified to the EPA.

Comment 12. Page 3-6 Exposure assessment: The final paragraph on page 3-6 indicates that site specific exposure parameters will be employed when available. The use of such site specific parameters must be approved by the EPA prior to application for quantitative risk assessment. Wherever applicable, the exposure parameters used in the off-post risk assessment will be consistent with those applied to the on-post Exposure Assessment.

Comment 13. Page 3-5 & 3-6, Section 3.4.1 There is no scenario (RMIE) which consists of "an individual currently living within the area where the effect on the air quality will be maximal".

Comment 14. Page 3-7 to 3-15 Except for dermal exposure, none of the exposure scenarios appear to consider absorbtion or bioavailability factors. Will a factor of "one" be assumed throughout? The dermal exposure values used are too low, check them against those values used in the ExA attached.

Comment 15. Page 3-9 Exposure Assessment: The authors apply soil/dust ingestion rates derived from 1989 Exposure Factors Handbook. Please see OSWER Directive 9850.4, January 27, 1989, "Interim Final Guidance for Soil Ingestion Rates".

Estimates of uptake of contaminants into garden vegetables should be based on empirical data derived from Travis and Arms (1988).

The fraction of homegrown fruits and vegetables which may be ingested by a farm family should be assumed to be 90%.

Comment 16. Page 3-11 Exposure Assessment: It seems very unlikely that exposure to surface water will occur at the rate indicated on page 3-11 of the Risk Assessment Protocol. To our knowledge, no one in the area is presently using surface water as a primary drinking water source.

Comment 17. Page 3-15, Section 3.5.1.1 What will be the exposure duration considered for noncarcinogenic effects?

Comment 18. Page 3-16 Use of a "quantitative" uncertainty analysis is not recommended. See Risk Assessment Guidance for Superfund (RAGS), Page 8-19.

Re: acute health effects. The assessment should consider other health effects that are not related to inhalations, like burning eyes, etc.

Comment 19. Exposure Assessment: Please apply Bioconcentration factors from EPA-503/8-89/002, September 1989 where applicable.

Comment 20. Exposure Assessment: Much information exists regarding the transfer of metals (particularly lead) from maternal sources to breast milk. It will not be acceptable to dismiss this pathway for the proposed incinerator.

EXHIBIT C

TABLE 8 (CONTINUED)
REASONABLE MAXIMUM EXPOSURE (RME) ESTIMATES
FOR THE EXPOSURE ASSESSMENT SCREENING EVALUATION

Parameter Name	Recreational Visitors	Regulated/Casual Visitors	Commercial Workers	Industrial Workers
Dermal Absorption (All compounds)	0.01 (metals) 0.10 (organics)	0.01 (metals) 0.10 (organics)	0.01 (metals) 0.10 (organics)	0.01 (metals) 0.10 (organics)
Body Weight	Adult: 70 kg Child: 10th percentile(M&F)	Adult: 70 kg Child: 10th percentile(M&F)	70 kg	70 kg
Area of Basement	NA1/	NA	138 m^2	138 m^2
Basement Volume	NA	NA	210 m^3	210 m^3
Basement Volume/ Surface Area Ratio	NA	NA	1.52 m	1.52 m
Depth of Basement Below Soil	NA	NA	2 m	2 m
Volume of Basement Air Inhaled	NA	NA	0.75 m^3/day	0.75 m^3/day
Time Per Basement Air Change	NA	NA	0.069 days/exchange	0.069 days/exchange
Soil Temperature	NA	NA	13°C	13°C
Soil Density	NA	NA	0.45 g/cm^3	0.45 g/cm^3
Soil Porosity - Air Space - Water Content	NA	NA	0.64 cm^3/cm^3 site specific site specific	0.64 cm^3/cm^3 site specific site specific
Soil Organic Content	NA	NA	0.001 (fraction)	0.001 (fraction)

1/ Not applicable

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TABLE 8
REASONABLE MAXIMUM EXPOSURE (RME) ESTIMATES FOR THE EXPOSURE ASSESSMENT SCREENING EVALUATION

On post

Parameter Name	Recreational Visitors	Regulated/Casual Visitors	Commercial Workers	Industrial Workers
Soil Ingestion	2 1/2 250 mg/day 6 250 mg/day Adult 100 mg/day	2 1/2 250 mg/day 6 250 mg/day Adult 100 mg/day	100 mg/day	100 mg/day
Breathing Rate	2 1/2 8.3 l/min 6 20.3 l/min Adult 24 l/min	2 1/2 4.2 l/min 6 13.3 l/min Adult 10 l/min	4.8 m^3/day	20 m^3/day
Dust Load Factor	0.042 mg/m^3	0.042 mg/m^3	0.021 mg/m^3	0.042 mg/m^3
Pulmonary Retention	0.75	0.75	0.75	0.75
Pulmonary Absorption (All compounds)	1 (100 percent)	1 (100 percent)	1 (100 percent)	1 (100 percent)
Exposure Period (Daily)	6 hours	6 hours	8 hours	8 hours
Exposure Frequency (Annual)	108 days/year	108 days/year	253 days/year	253 days/year
Exposure Duration (Lifetime)	70 years	30 years	30 years	30 years
Skin Surface Area	2 1/2 2,100 cm^2 6 2,500 cm^2 Adult 4,500 cm^2	2 1/2 2,100 cm^2 6 2,500 cm^2 Adult 4,500 cm^2	1,120 cm^2	3200 cm^2
Soil Covering	0.51 mg/cm^2	0.51 mg/cm^2	0.11 mg/cm^2	1.5 mg/cm^2
Soil Matrix	1.0	1.0	1.0	1.0

7470K

WESTON MANAGERS DESIGNERS/CONSULTANTS
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PHONE 215-692-3030
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December 26, 1990

Rocky Mountain Arsenal
Building 11
Commerce City, CO 80022-2180

Attn: Mr. Bruce Huenefeld
Office of the Program Manager
AMX RM-PM

PRAC Contract No. DACW45-90-0015
Delivery Order 5001
DCN: 3886-44-01-AATT

Subject: Rocky Mountain Arsenal
Basin F Liquid Incinerator
Response to Comments on WESTON Air Model/Risk
Assessment Protocol

Dear Mr. Huenefeld:

This letter summarizes WESTON's responses to the protocol review prepared by EPA Region VIII and received by WESTON on 19 Oct 90. We hope EPA and RMA concerns have been adequately addressed while maintaining as much consistency as possible with the previous published on-site and off-site exposure assessment work. Attached is a revised protocol which reflects the substance of the comments and WESTON's proposed modifications. We have also included the final list of contaminants, emissions data, a table of exposure parameters, and a table of toxicity criteria in an attachment to the revised protocol.

We received assistance from Dr. Chris Weis (EPA VIII) and Edwin Berry and Charlie Scharman (RMA) in terms of developing the final exposure assumptions and in obtaining background information on the "Off-Post FS" (i.e., the HLA/ESE Report).

RESPONSES TO COMMENTS

WESTON Comment to Cover Letter from Connally Mears to Don Campbell (18 Oct 90)

WESTON has provided clarification and more detail in the revised protocol on the methods used to determine the Submerged Quench Incinerator (SQI) emission rates for organics, metals, and products of incomplete combustion (PICS). WESTON's methodology incorporates comparison of predicted emissions from the waste stream and test burn data with an extensive emissions database for hazardous waste and municipal solid waste facilities. In the absence of empirical data, this approach provides a comprehensive and statistically defensible prediction of average and upper bound emission rates

WESTON

which can be meaningfully applied to the estimation of exposure in the risk assessment.

The exposure assumptions presented in the protocol have been revised to be as consistent as possible with both on-post (EBASCO Report) and off-post (HLA/ESE Report; Woodward Clyde Report) exposure assessments.

RESPONSES TO EPA VIII COMMENTS (EXHIBIT A)

AMBIENT AIR QUALITY MODELING PROTOCOL

Comment 1 — "All Other Compounds" refers to organic compounds other than dioxins/furans and PCBs. This has been corrected in the revised protocol. The statement concerning the trial burn has been added into Section 1.2 of the revised protocol.

Comment 2 — A preliminary review was based on inspection of the typographic maps of the SQI incinerator location out to 3 km to determine the approximate percentage of each of the land use as defined by Auer. Based on their approximate evaluation the percentage of land which could be classified as either rural or urban for air quality modeling purposes was greater than 50%. Thus the preliminary review indicates the area shown be classified as rural. A copy of Auer's method (Auer, 1978) for land use classification for air quality modeling purposes is attached.

Comment 3 — Receptors in the grid network used for modeling will include both areas of flat and elevated terrain.

Comment 4 — Concentrations will be estimated for all pollutants expected to be emitted by the SQI facility. A listing of the pollutants to be modeled is provided in the revised protocol (Appendix A).

Comment 5 — Terrain adjustments will be utilized in the WESDEP model. The terrain adjustments used in the WESDEP model are the same as those found in the USEPA Industrial Source Complex Short Term (ISCST) model and generally reduce the plume centerline distance to account for elevated terrain.

Comment 6 The WESDEP model outputs annual averages of concentration, dry deposition, deposition velocity, wet deposition, and total deposition for each receptor point.

Comment 7 Refer to Section 3.4.1 (Exposure Scenarios) of the revised protocol.

Comment 8 Surface roughness will be determined for each receptor by evaluating the area halfway to the adjacent receptors and assigning an appropriate surface roughness for the area reviewed.

RESPONSES TO EPA VIII COMMENTS (EXHIBIT B)

HEALTH RISK ASSESSMENT PROTOCOL

Comment 1 The "technological feasibility" statement has been deleted. It was not the intent of the statement to imply that the risk assessment was concerned with "technological feasibility" of lowering emissions limits. Rather it was to indicate that the risk assessors would provide assistance to the design engineering staff at WESTON in evaluating the individual chemical emission rates relative to health risk.

Comment 2 The Final Decision Document has been incorporated as a reference for guidance for the risk assessment.

Comment 3 Acute health effects will be addressed in the risk characterization phase should chronic noncarcinogenic hazard indices exceed unity. The last section of the protocol was inappropriately identified as "Acute Health Effects" instead of the intended "Upset Conditions Analysis". Note that "upset conditions" has been deleted from the revised protocol. It was WESTON's understanding from meeting with the Army and EPA that an upset condition analysis was not relevant to the establishment of emissions limits since a chronic toxicity assessment would be more conservative.

Comment 4	The "Contamination Identification" section of the protocol has been rewritten to address all concerns expressed by EPA relative to estimating emission rates for the contaminants of concern. All sources of information used have been clearly indicated.
Comment 5	The reference for destruction removal efficiency (DRE) is 40 CFR 264.343 ("Performance Standards). This reference has also been incorporated into Table 1-1 of the revised protocol.
Comment 6	Historical data used to calculate emissions rates for the risk assessment have been thoroughly discussed and cited in the revised protocol (Section 3.2). The revised protocol (Section 3.4.1 and Appendix A) presents key exposure parameters based on consultation with Dr. Chris Weis and Charlie Scharmann, and on review by WESTON of the off-post FS (HLA/ESE Report) and on-post (Ebasco Report) exposure assessments. The term "Hazard Index" has been appropriately clarified to indicate it refers to non-carcinogenic risk.
Comment 7	Deposition (both wet and dry) on leafy vegetable pathways is addressed in the protocol and will be evaluated in the risk assessment. We have reviewed the off-post exposure assessment (HLA/ESE Report) and incorporated for consistency and where appropriate, essential exposure parameters and all other pertinent, site specific background data for the risk assessment.
Comment 8	We will employ locally available soil concentrations for background metals if possible. Mr. Edwin Berry has referred us to Dr. William Trautman to obtain such data.
Comment 9	References for theories of PIC formation are Trenholm and Hathaway (1984) and Oppelt (1987) and are cited in the revised protocol. A statement referencing the <u>Final Decision Document</u> for pollutant selection has been incorporated in the revised protocol. We will be assessing non-carcinogenic risk through the soil and surface water pathways, and the protocol has been clarified appropriately. The "tier 1" analysis for surface water contamination is a screening method with very conservative assumptions to provide an initial cut

for contaminant selection. The method is described in more detail in the revised protocol (Section 3.1).

Comment 10 — WESTON has reviewed the Human Health Exposure Assessment Report (HLA/ESE). Appendix A contains a table summarizing those contaminants requiring derivation of toxicity criteria, and indicates those that follow the HLA Report. Preference will be given to IRIS (U.S. EPA Integrated Risk Information System) and to the most current U.S. EPA Health Effects Assessment Summary Tables. Dr. Chris Weis (EPA VIII) will be consulted for any questions concerning toxicity criteria or the development of exposure assumptions and scenarios. Attachment C (which contained various on-site exposure parameters) that was sent to us with EPA Region VIII comments was apparently taken from an older draft of the on-post Ebasco report. We have obtained all the current off-post and on-post exposure assessment assumptions and have incorporated these parameters in a table of assumptions included in the revised protocol.

Comment 11 — Dr. Chris Weis will be consulted on our approach in deriving any toxicity criteria.

Comment 12 — Any site specific exposure parameters used will be discussed with Dr. Chris Weis of EPA VIII. We have strived to be as consistent as possible between the off-post and on-post exposure assumptions previously developed.

Comment 13 — The RMEI at the point of maximum off-site dry deposition will also be exposed to the maximum off-site ambient ground level air concentration, based on the air modeling results. This is discussed in greater detail in Section 3.3.

Comment 14 — Toxicity criteria for ingestion and inhalation are based on administered dose, and therefore, it is not necessary to adjust for absorption. Where doses must be extrapolated from one route to another, absorption factors have been adjusted according to the guidance established in RAGS (U.S. EPA, 1989, Interim Final). Bioavailability for the inhalation and dermal pathways will be considered by using an inhalation retention factor of 0.75 and

a soil matrix factor of 0.15, respectively. In terms of dermal exposure parameters being too low, we assume EPA is referring to exposed skin surface area. The values in the Ebasco report (on-site) were based on a recreational use scenario and were, therefore, larger than the values we recommend which are more appropriate for a residential or worker scenario.

Comment 15

The soil/dust ingestion rates that will be used are those in OSWER Directive 9850.4 (1/27/89). Garden vegetable (leafy; fruits) uptake data are consistent with Travis and Arms (1988) and have been appropriately cited. We are in agreement with the 90% ingestion value of homegrown vegetables and fruits for farm families. These changes have been reflected in the revised protocol.

Comment 16

The surface water pathway for drinking water will not be applicable in this risk assessment. However, it was included in our protocol to indicate to EPA how we would initially approach evaluating exposure. Note that surface water will be a pathway in terms of fish consumption, as discussed in Section 3.4 of the revised protocol.

Comment 17

WESTON calculates a yearly average dose for soil-related exposure routes based on the maximum predicted soil concentration, which will occur at the end of the facility lifetime (i.e., at the end of year two). A yearly average dose is also calculated for the inhalation exposure route based on the predicted air concentration, which is assumed to remain constant during the operation of the facility. These predicted annual exposure doses are compared with non-carcinogenic reference doses (RFDs) in order to assess potential non-carcinogenic effects.

Comment 18

The uncertainty analysis to be presented will be consistent with RAGS (p 8-19). The statement on p. 3-16 of the original protocol was referring to a "sensitivity analysis". Acute "inhalation" criteria many times are based on acute irritant effects (mucous membranes; eyes; nasal passages; skin).

Comment 19 The revised protocol cites bioconcentration factors from EPA-503/8-89/002 where appropriate.

Comment 20 Dr. Chris Weis has indicated to us that transfer factor data for metals from maternal sources to milk are available and has provided a reference to this effect. We are evaluating this currently.

Please inform us in writing of your approval of this protocol, and/or of any additional comments or concerns you may have. If you have any immediate questions, call me (215-430-7276), Lou Militana (215-430-7217) or Paul Siebert (215-430-7207) concerning the risk assessment, air modeling or emission rate determination, respectively.

Sincerely,

ROY F. WESTON, INC

Robert O. Warwick Jr.

Robert O. Warwick, Jr., Ph.D., DABT
Section Manager, Risk Assessment

JOW/kh
Attachments
cc: Edwin Berry, RMA
Amit Sarkar, WESTON
Quintin Todd, WESTON
Lou Militana, WESTON
Charles Dobroski, WESTON
John Barone, WESTON
Gary Lage, WESTON
Paul Siebert, WESTON

rm011c.rpt

Correlation of Land Use and Cover with Meteorological Anomalies

AUGUST H. AUER, JR.

Department of Atmospheric Science, The University of Wyoming, Laramie 82071

(Manuscript received 26 January 1976, in final form 1 November 1977)

ABSTRACT

Aerial reconnaissance of the greater St. Louis area has led to the identification and classification of land use types. The land use classification provides as much compatibility as possible with other classification systems, yet offers the inclusion of percentage vegetative cover as an innovative characteristic of the land use description. The observed meteorological (thermodynamic, kinematic and radiative) anomalies in the vicinity of the metropolitan area are shown to be affiliated with "meteorologically significant" land cover characteristics.

It is suggested that the specific details of population, areal extent and type of metropolitan land cover must be considered in estimating the potential for inadvertent weather modification.

1. Introduction

It has been established in numerous empirical studies that city mesoclimates are markedly different from those over surrounding, more natural areas; i.e., city environments are usually warmer, drier, less wind, cloudier and have a larger particulate burden than their rural counterparts. The most extensive study of urban meteorology has been conducted under the auspices of Project METROMEX (Changnon *et al.*, 1971). The contrasting atmospheric properties seem to be the direct result of differential urban-rural energy disposition brought about by significant physical differences between cities and their surroundings; namely, the contrasting character of surface material (e.g., vegetation versus concrete), landscape shape and structure, heat sources and retention, and evapotranspiration.

While meteorologists for several decades have published information on urban climates, there is now a need to correlate these meteorological anomalies with more specific land use identification and description than are now used (such as "downtown, center of the city, residential, commercial," etc.). The purpose of this article is to identify some certain features of the land use in St. Louis that are unique and may be "meteorologically significant" in explaining some thermodynamic, kinematic and radiative anomalies associated with the overriding atmosphere of the metropolitan St. Louis area.

2. Procedure

Low-level airborne mapping and photography were used to establish our "meteorological" land use mosaic for Metropolitan St. Louis. As a standard procedure in its research activities, the University of Wyoming operated a Queen Air aircraft in the airspace over St. Louis. Aside from the computer-directed collection and recording of the meteorological and aircraft operational parameters, the data acquisition system is also equipped with an event marker. Event information, which is a discrete signal used to indicate up to 30 selected events such as specific land uses or photography, can be received from the pilot, copilot (scientist) and technician positions. In this manner, a designated event marker corresponding to a unique land use could be activated during the entire overflight of that land use. Among the aircraft operational parameters recorded are heading, VOR azimuth and DME position which allow plotting the aircraft flight path to within $\pm 1°$ and 0.2 km, respectively. Thus, flight paths, time and corresponding event markers were plotted yielding a land use mosaic. Only those flights or portions thereof at 150–300 m AGL (above ground level) were used to collect land use information to minimize downward line of sight errors. Scores of photographs were also taken to identify what was meant by a particular land use type as well as to aid in establishing the areal extent of the land use type. Voice recorders were utilized by crew members for complementary information regarding use of event markers and photography. Since the research flight paths were many and varied across the entire metropolitan area, an adequate density of land use data was acquired. No major modification in land use in the metropolitan area was noted in the observational period 1973–76.

There is no one ideal classification of land use and land cover, and it is unlikely that one could ever be developed. In developing our classification system, every effort has been made to provide as much compatibility as possible with other classification systems

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currently being used by the various Federal agencies involved in land use inventory and mapping (e.g., Anderson *et al.*, 1976). Our system satisfies the three major attributes of the classification process as outlined by Grigg (1965): 1) it gives names to categories by simply using accepted terminology; 2) it enables the classification scheme to be transferable; and 3) it allows inductive generalizations to be made. The classification system is capable of further refinement on the basis of more extended and varied use.

The approach to land use and land cover classification embodied in our system described herein is "meteorologically oriented," in contrast, for example, with the "people orientation" of Land Use Coding developed by the U. S. Urban Renewal Administration and the Bureau of Public Roads (1965).

3. Results

The analysis of the land use determination is shown in Fig. 1. The land use types in this classification assigned to the St. Louis Metropolitan area are listed in Table 1 along with a brief description of each. The types of land use and land cover categorization developed in this classification system can be related to other systems which classify the potential for any particular activity or land value. The classification is general enough to find utility in describing any metropolitan area land use as well as specific enough for association with relevant metropolitan anomalies.

For our use, the term "Metropolitan St. Louis area" has been assigned to that area encompassed by the outlying boundary of the normal residential (R1) land use. The Alton-Wood River, Ill., area (extreme northeast) has not been included in this metropolitan area, since it will be addressed separately. According to 1970 Census Bureau statistics, the City of St. Louis has a population of 622 236 (ranks 18) with a population density 3938 people per square kilometer (ranks 7). Census Bureau figures show a population of 2 363 017

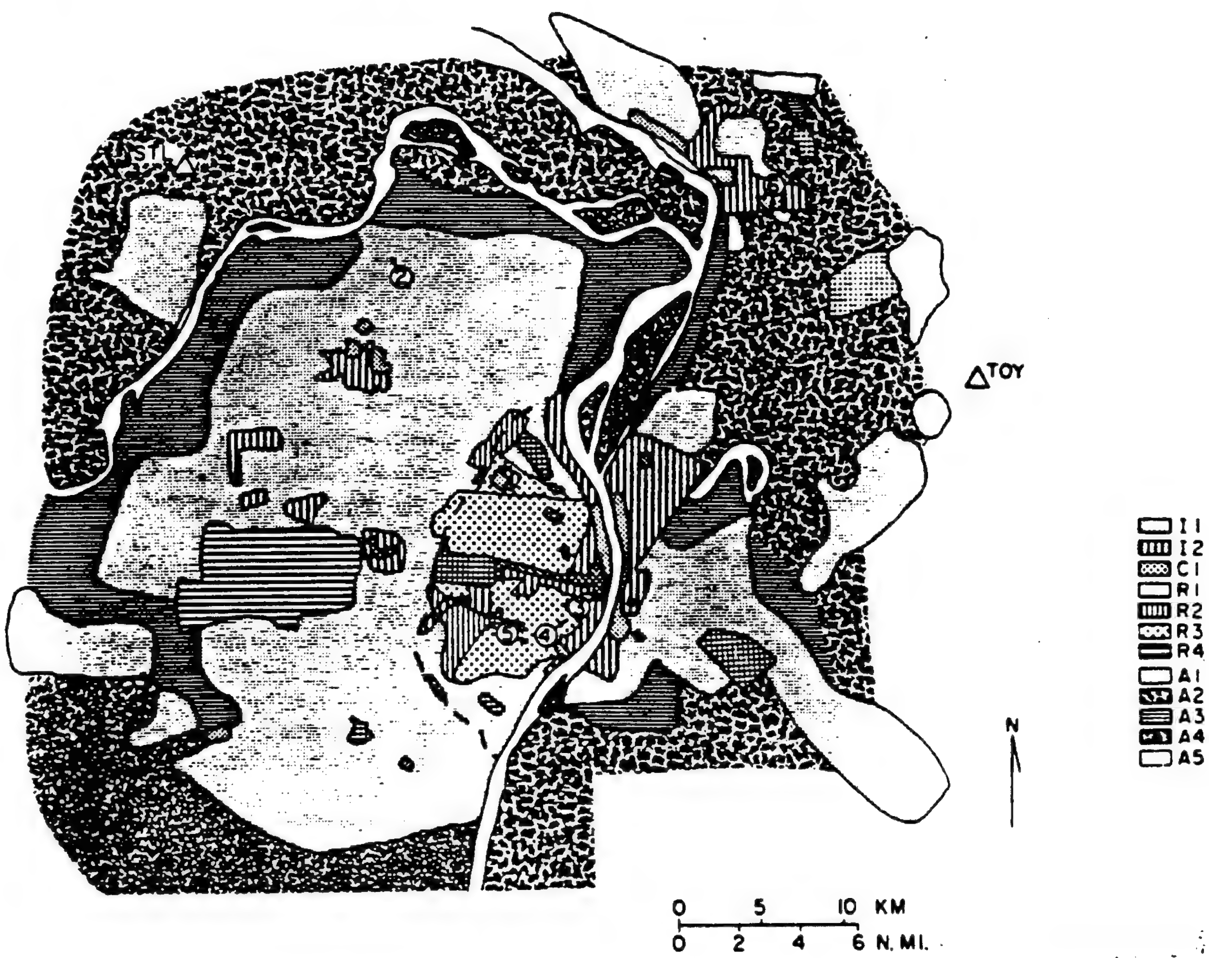

FIG. 1. Land use mosaic for the Metropolitan St. Louis area. Circled numbers with arrows show the location, viewing direction and figure number of accompanying photographs depicting examples of land use classification.

TABLE 1. Identification and classification of land use types found in Metropolitan St. Louis

Type	Description: Use and structures	Description: Vegetation
I1	Heavy industrial Major chemical, steel and fabrication industries; generally 3–5 story buildings, flat roofs	Grass and tree growth extremely rare; <5% vegetation
I2	Light-moderate industrial Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1–3 story buildings, flat roofs	Very limited grass, trees almost total absent; <5% vegetation
C1	Commercial Office and apartment buildings, hotels; >10 story heights, flat roofs	Limited grass and trees; <15% vegetation
R1	Common residential Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; >70% vegetation
R2	Compact residential Single, some multiple, family dwelling with close spacing; generally <2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; <30% vegetation
R3	Compact residential Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ashpits, no driveways	Limited lawn sizes, old established shade trees; <35% vegetation
R4	Estate residential Expansive family dwelling on multi-acre tracts	Abundant grass lawns and lightly wooded; >80% vegetation
A1	Metropolitan natural Major municipal, state, or federal parks, golf courses, cemeteries, campuses; occasional single story structures	Nearly total grass and lightly wooded; >95% vegetation
A2	Agricultural rural	Local crops (e.g., corn, soybean); >95% vegetation
A3	Undeveloped Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; >90% vegetation
A4	Undeveloped rural	Heavily wooded; >95% vegetation
A5	Water surfaces Rivers, lakes	

for a Metropolitan St. Louis.[1] An inspection of Fig. 1 collaborates the population density statistics since land use type R3 is seen to comprise approximately 40% of the area within the city limits.

Fig. 1 also shows the packing of land use types I1, I2, C1, R2 and R3 in the center of the metropolitan area. Since these land uses are comprised of only 5–30% vegetation and contain an abundance of man-made structures, a probable influence on meteorological anomalies is anticipated more than from a more "industrial" or "residential" classification.

Figs. 2–6 show representative views of some land use types shown in Fig. 1 and described in Table 1. An unabridged listing of land use photographs may also be found in Auer (1975b).

In particular, Figs. 4 and 5 highlight type R3. Since these residential structures seem to be coincident with most of the surface meteorological anomalies reviewed later, some additional description may be worthwhile. These multi-family dwellings (mostly two-family flats) were built circa 1915. Two features stand out clearly in Figs. 4 and 5: 1) nearly all dwellings are two-story and have flat, tarred roofs; and 2) the spacing between the buildings is very narrow (<2 m) with symmetry block after block. On-site estimates of the vegetative cover are less than 35%.

Table 2 gives a summary of the areal contributions according to land use types found in Metropolitan St. Louis. The contribution of streets, sidewalks and alleys to the total land use has not been included in Table 2. However, from input gleaned from aerial photographs,

[1] A more recent estimate compiled by the St. Louis Chapter of the American Statistical Association (*St. Louis Globe-Democrat*, 21 January 77) and the U. S. Census Bureau Report for 1975 Urban Population Estimates (*The Denver Post*, 13 April 77) still places the metropolitan population at 2.4 million but reduces the city population to 532 000.

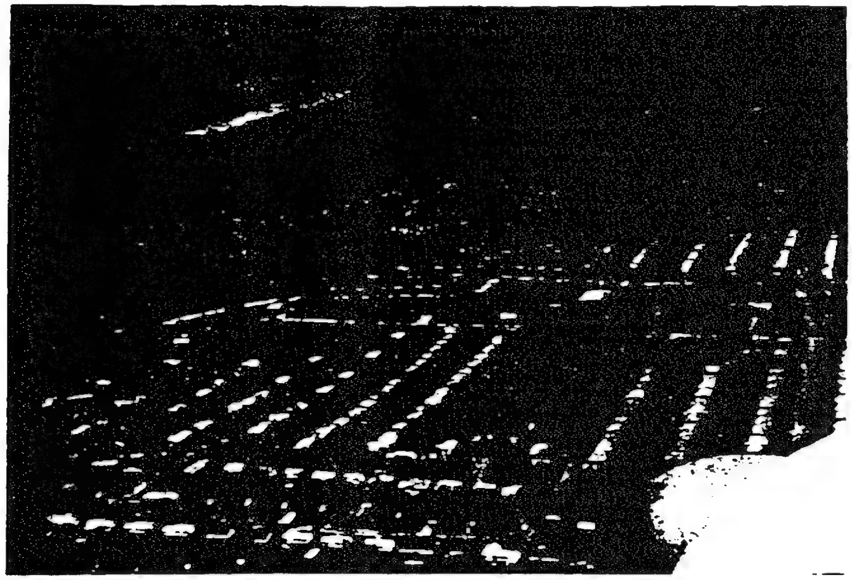

FIG. 2. View of normal residential land use (R1) in the northwestern suburbs of the metropolitan area. Flight altitude is 265 m AGL.

detailed road maps and Abell (1975),[2] area estimates of street and sidewalk thoroughfares for St. Louis city and the metropolitan area can be made, and as a first approximation, may be assumed proportionately distributed through land use types I-C-R. Within the city limits, 21.6 km^2 of street pavement and 6.5 km^2 of sidewalk are estimated, corresponding to 13.6% and 4.1%, respectively, of the total city area. Suburban estimates are placed at 147.1 km^2 (14.9%) and 46.8 km^2 (4.7%), respectively.

It should also be pointed out that the areal coverage of metropolitan natural (A1) land use is dominated by the contributions of a few large recreational parks and cemeteries throughout the metropolitan area (e.g., Forest Park, Calvary-Bellefontaine Cemetery). While there are numerous (over 175) examples of A1 land use, the vast majority are small in size and their effect is obscured by surrounding anthropogenic alterations.

Within the *city limits* of St. Louis, the integrated vegetative cover is estimated at approximately 45%. However, 70% (109 km^2) of the city area consists of I1-I2-C1-R2-R3 land use, adjacently located in the center of the city. These land uses collectively account for only a 25% vegetative surface. For the St. Louis Metropolitan area, the integrated vegetative cover is estimated at 65%.

At the extreme northeastern edge of the metropolitan area is the Alton-Wood River industrial complex. The principal industries in this area consist of steel smeltering and several petroleum refining complexes, dominated by the Shell Oil Refinery (see Fig. 6) at Wood River which ranks nationally among the top 12 refineries in terms of petroleum products output. The Alton-Wood River complex is addressed separately here because it has been demonstrated to be associated with some unusual and substantial increases in rainfall statistics (Schickedanz, 1974a) and clouds (Auer, 1976), although it is not large in areal extent and somewhat displaced from the other I1-I2-C1 land uses. The land use consists of types I1 and I2 with areas of 6.2 and 15.3 km^2, respectively; the associated domicile use is generally R1, covering about 50 km^2. While the land use may not seem impressive and conducive to weather anomalies, it should be noted that the refinery complex ranks as one of the strongest *localized* sources of heat (7×10^{11} cal h^{-1}) and water vapor (3×10^{8} g h^{-1}) output in the St. Louis region.

TABLE 2. Summary of areal coverages (km^2) of specific land uses for Metropolitan St. Louis, excluding waterways, thoroughfares and the Alton-Wood River industrial complex. Numbers in parentheses are percents.

Land use type	City of St. Louis	Suburbs Missouri	Suburbs Illinois	Metropolitan area
I1	5.4 (3)	4.2 (<1)	6.7 (3)	16.3 (1)
I2	21.4 (14)	14.6 (2)	33.9 (13)	69.9 (6)
C1	5.9 (4)	1.1 (≪1)	0.2 (≪1)	7.2 (<1)
R1	29.2 (18)	629.4 (87)	198.2 (75)	856.8 (75)
R2	13.3 (9)	2.2 (≪1)	—	15.5 (1)
R3	63.4 (40)	1.8 (≪1)	—	65.2 (6)
R4	—	53.3 (7)	—	53.3 (5)
A1	19.8 (12)	20.4 (3)	24.4 (9)	64.6 (6)
	158.4 (100)	727.0 (100)	263.4 (100)	1148.8 (100)
Total area	990.4			

[2] Abell, W., 1975: Personal communication. Administrative Assistant to the Director of Streets, Room 322, City Hall, St. Louis, Mo. 63103.

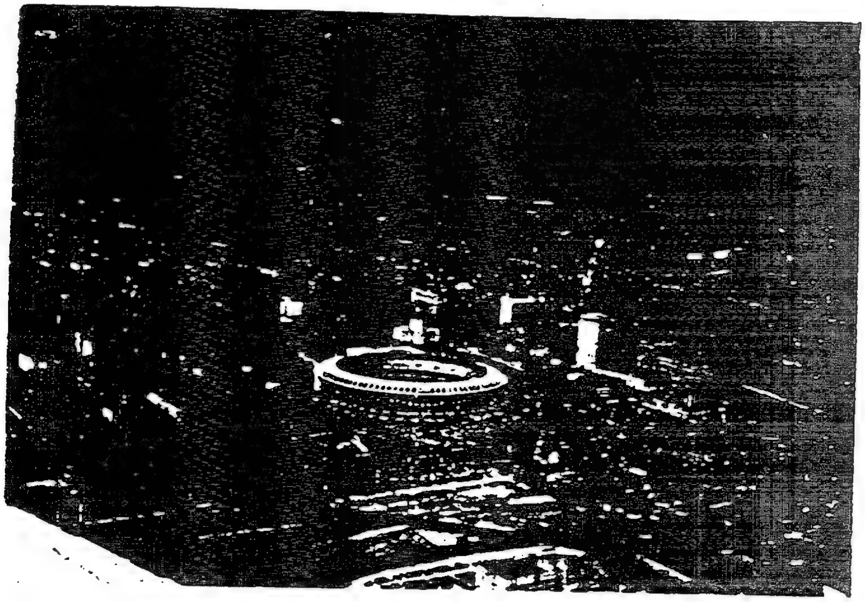

FIG. 3. View of light-moderate industrial land use (I2), foreground, with backdrop of commercial land use (C1), in the vicinity just south of "downtown" St. Louis. Flight altitude is 305 m AGL.

4. Implications

Certain types of land use, when adjacently located, can effectively alter surface characteristics, landscape structure, heat source and retention, and evapotranspiration, thereby increasing the dimensions of what has been termed "the urban area" in the literature on urban meteorology.

Like most large cities, St. Louis has a marked surface heat island (± 1.5 to ± 3.0°C) and a coincident (in space and time) identifiable minimum specific humidity (-0.5 to -1.5 g kg^{-1}) evident in the summer afternoon climatology (Jones, 1973; Jones and Schickedanz, 1974) as well as in summertime case studies (Dirks, 1974a,b; Sisterson, 1975). Temperature increases ($+1$°C) and specific humidity deficits (-1 g kg^{-1}) often extend a kilometer or more above the city and through the mixing layer to cloud bases (Auer and Changnon, 1977). An example of the thermodynamic anomalies in Fig. 7 is reproduced from Dirks (1974b) and clearly shows the

FIG. 4. View of compact residential land use (R3) to the south of "downtown" St. Louis. Flight altitude is 305 m AGL.

FIG. 5. Closeup view of compact residential land use (R3) in the southern sections of the City of St. Louis. Flight altitude is 235 m AGL.

developed mid-afternoon urban heat island and specific humidity deficit at 305 m AGL essentially associated with R1-R2-C1-R3 land use. Note the small area of 1.5 g kg^{-1} humidity deficit just to the west of the city limits which seems to coincide with the I2-C1 land use of downtown Clayton and nearby industrial parks. Dirks (1974a) and Sisterson (1975) suggested that the lack of evaporating surfaces, such as comprise the I1-I2-C1-R3 land use, could account for a significant reduction in evapotranspiration over these portions of the metropolitan area, observable as a specific humidity deficit.

Thermal perturbations, along with the effect of increased surface friction, may alter the airflow across a metropolitan area. The low-level airflow under light and moderate wind conditions has been found to be markedly perturbed by the city and often results in distinct convergence in or just downwind of the city center (Ackerman, 1974a,b, 1977; Auer, 1975a; Sisterson, 1975; Kropfli and Kohn, 1977; Wong and Dirks, 1978).

The thermodynamic anomalies in the mixing layer over the city are reflected in the preferred areas in and downwind of the urban area for the initiation of cumulus clouds, seasonally (Schickedanz, 1974b) and by case study (Auer, 1974, 1976). Convective cloud bases are generally higher by 200–600 m over and slightly downwind of the city (Ackerman and Appleman, 1974; Boatman and Auer, 1974; Semonin and Changnon, 1974; Changnon *et al.*, 1976; Shea and Auer, 1978).

Anomalies in radiation parameters have also been documented in St. Louis. A nighttime infrared surface heat island has been shown to stand out clearly over the downtown St. Louis area (Braham, 1974). Reduced albedo values of 11–13% have been found for commercial-industrial-old residential sites contrasted with albedo values of 16–22% for surrounding rural areas (Dabberdt and Davis, 1974; White *et al.*, 1978). Variations in albedo and emitted terrestrial radiation, related to mesoscale changes in land use and cover, have been found responsible for differences in net radiation accumulated within the St. Louis metropolitan and surrounding rural areas (White *et al.*, 1978).

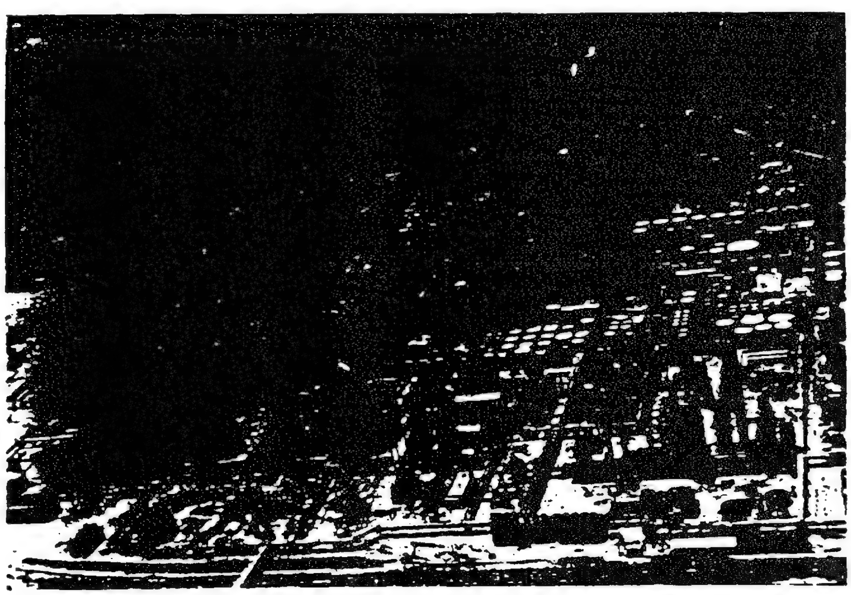

FIG. 6. Closeup view of heavy industrial land use (I1) showing the Wood River, Ill., oil refinery complex, with adjoining normal residential (R1) and agricultural rural (A2) land uses. Flight altitude is 455 m AGL.

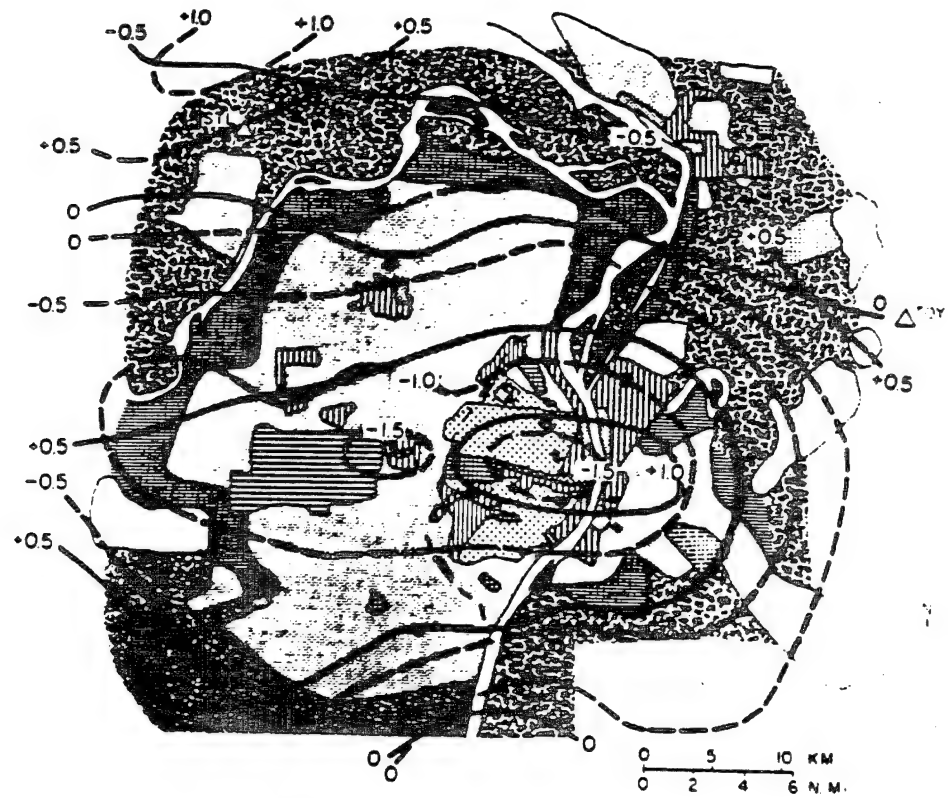

FIG. 7. Analysis of urban temperature (°C, solid) and specific humidity (g kg^{-1}, dashed) anomalies with respect to upwind values at 305 m AGL for 1145–1500 CDT 23 August 71 (after Dirks, 1974b). The land use analysis is repeated from Fig. 1.

It is recognized that no single land use type may, by itself, be responsible for a particular thermodynamic, kinematic or radiative anomaly. There may indeed be interactive and feedback processes between land use types and anomalies which are not yet clearly understood. However, evidence from METROMEX nourishes the premise that there is a direct interaction between land use type and anomaly since certain land use types are coincident with some observed surface anomaly locations.

Schickedanz (1974a) has documented anomalous characteristics of summertime convective rainfall across the Metropolitan St. Louis area. Grosh and Semonin (1973), Boatman and Auer (1974), Changnon and Semonin (1975) and Changnon *et al.* (1976) have observed thunderstorm occurrence of the type studied by Schickedanz and concluded that temperature and specific humidity anomalies associated with the urban surface and overriding mixing layer can alter storm behavior and possibly explain the 20–30% precipitation increases (Huff and Vogel, 1977) in the localized area within 40 km of the city center.

In his review of urban climatic rainfall patterns, Changnon (1976) concluded that a critical size of metropolitan population (>1 000 000) must be attained before a metropolitan area affects rainfall downwind. Furthermore, since sizeable rainfall increases were found in non-industrial cities, as well as in industrial cities with widely varying industrial bases, the rainfall anomalies seem associated with thermodynamic and/or kinematic characteristics of the land cover.

Thus, it appears that some specific details of population, size and type of natural landscape alteration must be considered in estimating the potential of inadvertent precipitation modification. Land use types of I1-I2-C1-R2-R3, which cover as little as 100 km^2 in the case of St. Louis, should be suspect for mesoscale thermodynamic anomalies sufficient to cause inadvertent precipitation modification.

If meteorological land use types, as listed in Table 1, and areas of coverage, as shown in Table 2, can be identified for other urban studies, better comparisons and transfer of analyses can be made through stratification by land use. Eventually it is hoped that the recognition of the meteorological land use typ[illegible] proposed herein will find their place in the format o[illegible] [illegible]ning ar[illegible] [illegible]scribing the anomaly, identifying responsible [illegible]ial processes, linking these processes to anthropogenic

activities, and ultimately relating these findings to the translation and prediction of anomalies in other metropolitan areas.

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APPENDIX 7A

DERIVATION OF SURFACE WATER POLLUTANT CONCENTRATIONS
FOR ENGINEERS LAKE

TIER 1 AND 2 ANALYSIS

APPENDIX 7A

DERIVATION OF SURFACEWATER POLLUTANT CONCENTRATIONS FOR ENGINEERS LAKE

7A.1 INTRODUCTION

This appendix presents a detailed discussion of the methods used to determine the surface water contaminant concentrations for Engineers Lake. The Tier 1 analysis describes the technique used initially to screen contaminants from further evaluation in the surface water pathways (EPA, 1986). The Tier 2 analysis explains the derivation of final contaminant concentrations used in estimating the exposure doses for the surface water pathways in the risk assessment.

7A.2 TIER 1 ANALYSIS

Water concentrations of certain contaminants were predicted using the conservative Tier 1 methodology and compared with the appropriate health-based criteria. Contaminants predicted to have water concentrations exceeding these criteria will be selected for further evaluation in the risk assessment. Those contaminants with concentrations less than the health-based criteria will not be subsequently evaluated.

The focus of the Tier 1 screening was to eliminate contaminants from the fish ingestion pathway, which is the only surface water-related pathway, evaluated in the risk assessment. As a result, only a subset of the total list of contaminants was screened using the Tier 1 methodology. Volatile organic compounds were not considered in this analysis since they are neither expected to accumulate in surface water nor bioaccumulate in fish.

With the objective of developing a conservative carcinogenic risk estimate, all oral

carcinogens are arbitrarily evaluated through all relevant exposure pathways in the final risk assessment, therefore were not screened in the Tier 1 analysis.

The final criterion for inclusion in the Tier 1 screening was the availability of appropriate health-based water quality values. Only those nonvolatile, noncarcinogenic compounds, which had ambient water quality criteria for the protection of human health through fish ingestion, were screened in the Tier 1 analysis. These factors resulted in the evaluation of the three organic and six inorganic contaminants listed below.

<u>Organics</u>
Fluoranthene
Pentachlorobenzene
Tetrachlorobenzene

<u>Inorganics</u>
Antimony
Chromium (III)
Manganese
Mercury
Nickel
Thallium

Sensitivity case emission rates, which represent the maximum or upper-bound range of facility emissions, were used in the Tier 1 screening to maximize the contaminant concentrations in Engineers Lake. It was conservatively assumed that all contaminants deposited in the watershed of Engineers Lake in a one-year period would enter the lake as runoff. The decay and degradation of contaminants in surface water, soil, or air were not considered in this analysis, further maximizing the predicted lake water concentrations. The equations employed in the Tier 1 screening are presented as follows in the following text.

The total annual basin deposition rate was calculated using the following equation:

$$TBD = ER * DR * BA$$

Where:

TBD	=	Total basin deposition (g/yr)
ER	=	Sensitivity case emission rates (g/sec)
DR	=	Total (wet plus dry) deposition factor, 9.00E-04 (g/m^2 yr)/(g/sec)
BA	=	Basin area, 1.30E+05 m^2

The water concentration in Engineers Lake was calculated using the following equation:

$$Cwater = TBD * HRT * CF1 * CF2/VOL$$

Where:

Cwater	=	Contaminant concentration in Engineers Lake (mg/L).
TBD	=	Total basin deposition (g/yr).
HRT	=	Hydraulic residence time (assumed 0.5 yr).
CF1	=	Conversion factor, 1.00E-03 m^3/L.
CF2	=	Conversion factor, 1.00E+03 mg/g.
VOL	=	Lake volume, 3.45E+05 m^3 (Adams County Parks Department).

The emission rates, water concentrations, and ambient water quality criteria used in the Tier 1 screening are presented in Table 7A-1. Table 7A-1 shows that none of the contaminants eligible for the Tier 1 screening exceeds 10 percent of their respective ambient water quality criteria for protection of human health through fish ingestion. As a result, these compounds are not evaluated in the fish ingestion pathway.

7A.3 TIER 2 ANALYSIS

A Tier 2 transport model was developed to predict surface water contaminant concentration from soil runoff and aerial deposition of pollutants in Engineers Lake for the fish ingestion pathway. The Tier 2 model has less conservative assumptions and provides more realistic values than the Tier 1 model. Water concentrations were calculated for all pollutants except particulate matter, acid gases, volatile organic compounds, and contaminants

Table 7A-1

Tier 1 Surface Water Pollutant Concentrations and Comparison To Standards

Pollutant	Sensitivity Case Emission Rate (g/sec)	Predicted Annual Surface Water Concentration (mg/L)	AWQC for Protection of Human Health* (mg/L)
Organics			
Fluoranthene	1.91E-09	3.23E-13	5.40E-02
Pentachlorobenzene	9.73E-12	1.64E-15	8.50E-02
Tetrachlorobenzene	4.12E-12	6.93E-16	4.80E-02
Inorganics			
Antimony	3.90E-03	6.58E-07	4.50E+01
Chromium (III)	1.20E-05	2.02E-09	3.43E+03
Manganese	2.50E-04	4.22E-08	1.00E-01
Mercury	3.90E-03	6.58E-07	1.46E-04
Nickel	1.07E-03	1.81E-07	1.00E-01
Thallium	3.90E-03	6.58E-07	4.80E-02

* U.S. EPA. 1986. Quality Criteria for Water. 1986. Office of Water Regulations and Standards. EPA 440/5-86-001.

excluded as a result of the Tier 1 analysis. The technical approach and assumptions of the Tier 2 model are presented in the subsections that follow.

7A.3.1 Prediction of Surface-Water Concentrations of Pollutants

To estimate the potential exposure to the pollutants through fish consumption, surface water pollutant concentrations were predicted using the following steps:

- Calculation of the average deposition rate within the watershed
- Estimation of soil loss to Engineers Lake within the watershed
- Determination of pollutant concentrations in Engineers Lake

This approach to determining surface-water concentrations is based on the estimation of pollutant deposition on Engineers Lake and watershed soils and the subsequent runoff of pollutants to the lake. The concentrations are based on an assumed facility life of two years.

7A.3.2 Calculation of the Average Deposition Rate (DR) Within the Watershed

The first step in estimating the chronic surface-water concentrations involves a determination of the deposition factor for the impacted area. The watershed of Engineers Lake is limited in size and surrounded by major roadways. Due to the small size of the watershed, deposition in the entire area was described by a single rate, which precluded having to average the deposition over a wider area. The total deposition factor for the watershed is 9.00E-04 $(g/m^2yr)/(g/sec)$.

7A.3.3 Estimation of Soil Loss to Engineer's Lake

Data that could be used to predict soil erosion within the Engineers Lake watershed were not available. As a result, soil loss was conservatively estimated at 1.5 tons/acre-yr or 336 g/m^2-yr.

7A.3.3.1 Contaminant Loss Rate

To estimate the soil contaminant concentrations being transported to the lake, it is first necessary to estimate the rate constants for contaminant loss from soils. The contaminant loss rate is based on contaminant loss through the two potential loss mechanisms. They include the surface runoff rate (K_1r), which is based on the loss of soil particles as they are transported to the lake, and the chemical degradation rate (K_1d), which is based on the half-life of the contaminants in the soil.

The surface water runoff rate (K_1r) was calculated as follows:

$$K_1r \quad = \quad X_t / (B * d)$$

Where: Estimated Value

K_1r	=	Surface runoff rate	= 0.00118 per year
X_t	=	Total sediment loss rate	= 336.24 g/m^2-yr
B	=	Bulk density	= 1,425,000 g/m^3 (Alan Price, personal communication, 1990)
d	=	Depth of incorporation	= 0.2 meter

The chemical degradation rate (K_1d) was calculated for each chemical of concern as follows:

$$K_1d \quad = \quad \ln 2/t_{1/2}$$

Where:

K_1d = Chemical degradation rate (per year).
$t_{1/2}$ = Chemical half-life in soil (years).

The combined contaminant loss rate was calculated using the following equation:

$$K_1 = K_1r + K_1d$$

The contaminant loss rates for soils in the Engineers Lake watershed are presented in Table 7A-2, along with the chemical half-lives in soils used in these calculations.

No allowances were made for infiltration losses. Although these losses can be significant, it is beyond the scope of this analysis to determine the extent of groundwater recharge in the basin. Therefore, it is conservatively assumed that no loss to groundwater occurs. This conservative assumption increases the soil concentrations and thus the surface water concentrations.

7A.3.3.2 Determination of Steady State Soil Concentrations

Based on the rate of deposition and the loss of contaminants in soil from surface runoff and degradation, the steady state soil concentrations for each contaminant evaluated that will accumulate during the operation of the facility were calculated as follows:

$$Mn = (K_2/K_1) * (1 - e^{-K_1 t}) * CF/(d * B)$$

Where:

Mn = Maximum contaminant soil concentration (g/kg).
K_2 = Annual deposition rate for contaminant (g/m^2-year).
K_1 = Contaminant loss rate (per year).
t = Life of the incinerator (2 yrs).
d = Depth of incorporation (0.2 m).
B = Bulk density (1.425E+06 g/m^3).
CF = Conversion factor (1,000 g/kg).

Table 7A-2

Contaminant Loss Rates and Half-Lives for Soils in the Engineers Lake Watershed

Pollutant	K1 (per year)	Half Life (years)
ORGANICS		
Acetonitrile	1.87E-03	1.00E+03
Aldrin	1.87E-03	1.00E+03
Atrazine	1.39E+00	5.00E-01
Benzaldehyde	1.87E-03	1.00E+03
Benzofuran	1.87E-03	1.00E+03
Benzoic Acid	1.87E-03	1.00E+03
Benzonitrile	1.87E-03	1.00E+03
Biphenyl	1.87E-03	1.00E+03
Carbazole	1.87E-03	1.00E+03
4-Chlorobiphenyl	1.87E-03	1.00E+03
4,4-Chlorobiphenyl	1.87E-03	1.00E+03
4Chlorophenylmethylsulfone	6.94E-01	1.00E+00
4-Chlorohpenylmethylsulfoxide	6.94E-01	1.00E+00
p,p-DDE	7.82E-02	9.00E+00
p,p-DDT	7.82E-02	9.00E+00
Dibenzofuran	1.87E-03	1.00E+03
Dieldrin	1.87E-03	1.00E+03
Diisopropyl Methylphosphonate	3.48E-01	2.00E+00
1,3-Dimethylbenzene	1.87E-03	1.00E+03
Dimethyl Methylphosphonate	2.04E+01	3.40E-02
Dimethylphosphate	1.87E-03	1.00E+03
Dioxins/Furans (EPA TEFs)	5.89E-02	1.20E+01
Dithiane	1.87E-03	1.00E+03
Endrin	7.05E-02	1.00E+01
Hexachlorobenzene	1.17E-01	6.00E+00
Hexachlorocyclopentadiene	1.87E-03	1.00E+03
Isodrin	1.87E-03	1.00E+03
Malathion	1.87E-03	1.00E+03
Methanol	1.87E-03	1.00E+03
4-Nitrophenol	1.87E-03	1.00E+03
PAHs		
Acenaphthalene	1.87E-03	1.00E+03
Acenaphthene	1.87E-03	1.00E+03
Benzo(a)pyrene	8.20E-01	8.47E-01
Chrysene	6.55E-01	1.06E+00
Dibenzo(a,h)anthracene	6.04E-01	1.15E+00
Fluorene	1.87E-03	1.00E+03
Phenanthrene	9.45E-01	7.34E-01
Pyrene	9.74E-01	7.12E-01
Parathion	1.87E-03	1.00E+03
Phenol	1.87E-03	1.00E+03
Pyridine	1.87E-03	1.00E+03
Quinoline	1.87E-03	1.00E+03
Supona	1.87E-03	1.00E+03
Trichlorobenzene	1.87E-03	1.00E+03
Urea	1.87E-03	1.00E+03
Vapona	1.87E-03	1.00E+03
INORGANICS		
Aluminum	1.87E-03	1.00E+03
Arsenic	1.87E-03	1.00E+03
Barium	1.87E-03	1.00E+03
Beryllium	1.87E-03	1.00E+03
Boron	1.87E-03	1.00E+03
Cadmium	1.87E-03	1.00E+03
Calcium	1.87E-03	1.00E+03
Chromium (III)	1.87E-03	1.00E+03
Chromium (VI)	1.87E-03	1.00E+03
Cobalt	1.87E-03	1.00E+03
Copper	1.87E-03	1.00E+03
Iron	1.87E-03	1.00E+03
Lead	1.87E-03	1.00E+03
Lithium	1.87E-03	1.00E+03

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Table 7A-2
(continued)

Manganese	1.87E-03	1.00E+03
Molybdenum	1.87E-03	1.00E+03
Phosphorus (total)	1.87E-03	1.00E+03
Potassium	1.87E-03	1.00E+03
Selenium	1.87E-03	1.00E+03
Silicon	1.87E-03	1.00E+03
Silver	1.87E-03	1.00E+03
Sodium	1.87E-03	1.00E+03
Strontium	1.87E-03	1.00E+03
Tin	1.87E-03	1.00E+03
Titanium	1.87E-03	1.00E+03
Vanadium	1.87E-03	1.00E+03
Yttrium	1.87E-03	1.00E+03
Zinc	1.87E-03	1.00E+03

The annual deposition rates (K_2) were calculated by multiplying the chemical-specific emission rates by the deposition factor of 9.00E-04 g/m^2-year per g/sec. The maximum contaminant soil concentrations, as well as the emission rates and annual deposition rates used in the calculations, are presented in Table 7A-3.

7A.3.4 Determination of Contaminant Concentration (C) in the Receiving Water

The receiving water contaminant concentration is a function of the suspended solids in the inflow and outflow, as well as the concentration of contaminants in the soil. No data were available for the suspended solids concentration of Engineers Lake. Therefore, it was assumed that the lake had a suspended solids outflow concentration of 100 mg/L.

The inflowing suspended solids concentration was based on the conservative assumption that 95 percent of inflowing suspended sediments settle out in Engineers Lake. The equations used to calculate the impoundment contaminant concentration are:

$$Si = So/(1-RE)$$
$$Ci = Si * Mn * CF$$

Where:

Si = Suspended solids concentration in inflow (mg/L)
So = Suspended solids concentration in outflow (100 mg/L) (assumed value)
RE = Suspended solids removal efficiency (assume 95 percent)
Ci = Inflow total concentration (ng/L)
Mn = Maximum soil concentration (g/kg)
CF = Conversion factor, 1,000 mg/g

Table 7A-3

Maximum Contaminant Soil Concentrations, Emission Rates, and Annual Deposition Rates in the Engineers Lake Watershed

Pollutant	Soil Concent (g/Kg)	EMISSION RATE g/sec	Annual Deposition (g/m2-year)
ORGANICS			
Acetonitrile	1.48E-16	2.35E-11	2.11E-14
Aldrin	1.57E-18	2.49E-13	2.24E-16
Atrazine	1.18E-19	5.53E-14	4.98E-17
Benzaldehyde	3.22E-14	5.10E-09	4.59E-12
Benzofuran	6.17E-14	9.79E-09	8.81E-12
Benzoic Acid	1.56E-14	2.47E-09	2.22E-12
Benzonitrile	1.48E-17	2.35E-12	2.11E-15
Biphenyl	1.54E-14	2.45E-09	2.20E-12
Carbazole	2.96E-18	4.70E-13	4.23E-16
4-Chlorobiphenyl	1.79E-14	2.84E-09	2.56E-12
4,4-Chlorobiphenyl	2.35E-16	3.72E-11	3.35E-14
4Chlorophenylmethylsulfone	3.10E-18	9.08E-13	8.17E-16
4-Chlorohpenylmethylsulfoxide	1.15E-17	3.38E-12	3.04E-15
p,p-DDE	2.42E-15	4.14E-10	3.73E-13
p,p-DDT	4.85E-19	8.29E-14	7.46E-17
Dibenzofuran	3.08E-15	4.89E-10	4.40E-13
Dieldrin	3.22E-19	5.11E-14	4.60E-17
Diisopropyl Methylphosphonate	4.09E-17	8.98E-12	8.08E-15
1,3-Dimethylbenzene	6.17E-15	9.79E-10	8.81E-13
Dimethyl Methylphosphonate	3.31E-17	2.14E-10	1.93E-13
Dimethylphosphate	3.70E-16	5.87E-11	5.28E-14
Dioxins/Furans (EPA TEFs)	5.19E-16	8.71E-11	7.84E-14
Dithiane	5.66E-20	8.98E-15	8.08E-18
Endrin	2.93E-19	4.97E-14	4.47E-17
Hexachlorobenzene	9.41E-17	1.67E-11	1.50E-14
Hexachlorocyclopentadiene	2.92E-18	4.63E-13	4.17E-16
Isodrin	8.26E-19	1.31E-13	1.18E-16
Malathion	1.26E-18	2.00E-13	1.80E-16
Methanol	3.58E-14	5.68E-09	5.11E-12
4-Nitrophenol	1.30E-17	2.07E-12	1.86E-15
PAHs			
Acenaphthalene	1.54E-14	2.45E-09	2.20E-12
Acenaphthene	1.54E-14	2.45E-09	2.20E-12
Benzo(a)pyrene	1.52E-15	4.89E-10	4.40E-13
Chrysene	1.72E-15	4.89E-10	4.40E-13
Dibenzo(a,h)anthracene	1.79E-15	4.89E-10	4.40E-13
Fluorene	3.08E-15	4.89E-10	4.40E-13
Phenanthrene	2.78E-15	9.79E-10	8.81E-13
Pyrene	1.36E-15	4.89E-10	4.40E-13
Parathion	1.74E-19	2.76E-14	2.48E-17
Phenol	1.67E-13	2.65E-08	2.38E-11
Pyridine	1.48E-18	2.35E-13	2.11E-16
Quinoline	7.38E-18	1.17E-12	1.05E-15
Supona	5.23E-19	8.29E-14	7.46E-17
Trichlorobenzene	1.05E-17	1.66E-12	1.49E-15
Urea	2.26E-13	3.59E-08	3.23E-11
Vapona	1.39E-18	2.21E-13	1.99E-16
INORGANICS			
Aluminum	4.09E-09	6.49E-04	5.84E-07
Arsenic	8.13E-10	1.29E-04	1.16E-07
Barium	1.99E-10	3.16E-05	2.84E-08
Beryllium	8.32E-12	1.32E-06	1.19E-09
Boron	6.07E-09	9.63E-04	8.67E-07
Cadmium	2.37E-11	3.76E-06	3.38E-09
Calcium	3.49E-08	5.53E-03	4.98E-06
Chromium (III)	5.41E-11	8.58E-06	7.72E-09
Chromium (VI)	1.90E-12	3.02E-07	2.72E-10
Cobalt	1.79E-10	2.84E-05	2.56E-08
Copper	7.63E-07	1.21E-01	1.09E-04
Iron	1.08E-08	1.72E-03	1.55E-06
Lead	2.55E-10	4.05E-05	3.64E-08

Table 7A-3
(continued)

Lithium	2.50E-11	3.96E-06	3.56E-09
Manganese	3.24E-08	5.14E-03	4.63E-06
Molybdenum	2.50E-09	3.97E-04	3.57E-07
Phosphorus (total)	7.75E-07	1.23E-01	1.11E-04
Potassium	2.58E-07	4.09E-02	3.68E-05
Selenium	2.09E-06	3.31E-01	2.98E-04
Silicon	3.59E-08	5.70E-03	5.13E-06
Silver	2.16E-08	3.43E-03	3.09E-06
Sodium	2.65E-05	4.21E+00	3.79E-03
Strontium	8.32E-12	1.32E-06	1.19E-09
Tin	1.83E-09	2.91E-04	2.62E-07
Titanium	1.39E-11	2.20E-06	1.98E-09
Vanadium	5.31E-10	8.42E-05	7.58E-08
Yttrium	4.85E-12	7.70E-07	6.93E-10
Zinc	3.69E-09	5.86E-04	5.27E-07

7A.3.5 Aerial Deposition on Engineers Lake

Direct aerial deposition onto Engineers Lake represents an additional source of pollutants. The contribution by direct deposition was calculated by first determining the total deposition factor for the lake. This factor, 9.00E-04, is the same as that described previously for soil loss.

The concentration due to deposition was calculated by determining the mass of pollutants falling onto 1 square meter of lake surface. The pollutant mass was then mixed in the volume of water underlying the square meter of lake surface, which was based on an average depth of six meters (Nancy Koenig, Personal Communication, 1990). An assumed hydraulic residence time of 0.5 year was factored into the final equation to account for pollutant loss by outflowing water. The equation used to calculate the concentration from direct deposition is:

$$Md = SA * K2i * Tr$$

Where:

Md = Mass deposited directly into unit volume (grams)
SA = Unit surface area (1 m^2)
K2i = Area-weighted deposition (g/yr m^2)
Tr = Hydraulic residence time (0.5 year)

The contaminant concentration from sedimentation and aerial deposition were combined in the following equation to form an intermediate water concentration:

$$Ci2 = Ci + ((Md * NGG)/Vp)$$

Where:

Ci2	=	Intermediate unit volume concentration (ng/L)
Ci	=	Contaminant concentration due to erosion losses (ng/L)
Md	=	Mass due to aerial deposition (g)
Vp	=	Volume of water under 1 m^2 of lake surface (L), based on average depth of 6.0 meters (Adams County Parks Dept, 1990)
NGG	=	Conversion factor for grams to nanograms (1E+09 ng/g)

The concentration of contaminants in Engineers Lake is a function of the intermediate concentration, Ci2, the suspended solids concentration in outflow and inflow, and partitioning of the contaminant between dissolved and solid phases. The equation, which is presented below, represents the total water column concentration and takes into account dissolved and particle bound contaminants.

Ct = Ci2 * (1+(So * Kp * KGMG))/(1+Si * Kp * KGMG))

Where:

Ct	=	Total water column concentration
Ci2	=	Intermediate unit volume concentration (ng/L)
So	=	Suspended solids concentration in outflow (mg/L)
Kp	=	Partition coefficient (L/kg)
KGMG	=	Conversion factor (1E-06 kg/mg)
Si	=	Suspended solids concentration in inflow (mg/L)

The water concentrations and partition coefficients used in the fish ingestion pathway are presented in Tables 7A-4 and 7A-5, respectively.

Table 7A-4

Surface Water Concentrations for Contaminants of Concern in Fish Ingestion Exposure Pathways

Pollutant	Water Concentration for Fish Pathway (mg/L)
ORGANICS	
Acetonitrile	2.03E-15
Aldrin	1.08E-18
Atrazine	2.31E-18
Benzaldehyde	4.17E-13
Benzofuran	4.58E-13
Benzoic Acid	1.87E-13
Benzonitrile	1.90E-16
Biphenyl	6.23E-14
Carbazole	9.91E-18
4-Chlorobiphenyl	1.37E-14
4,4-Chlorobiphenyl	1.65E-16
4Chlorophenylmethylsulfone	7.11E-17
4-Chlorohpenylmethylsulfoxide	2.62E-16
p,p-DDE	1.80E-15
p,p-DDT	3.56E-19
Dibenzofuran	3.58E-15
Dieldrin	2.22E-19
Diisopropyl Methylphosphonate	6.76E-16
1,3-Dimethylbenzene	2.35E-14
Dimethyl Methylphosphonate	1.59E-14
Dimethylphosphate	5.07E-15
Dioxins/Furans (EPA TEFs)	3.76E-16
Dithiane	7.68E-19
Endrin	2.68E-19
Hexachlorobenzene	7.33E-17
Hexachlorocyclopentadiene	2.06E-18
Isodrin	5.68E-19
Malathion	7.30E-18
Methanol	4.91E-13
4-Nitrophenol	7.37E-17
PAHs	
Acenaphthalene	1.88E-14
Acenaphthene	2.20E-14
Benzo(a)pyrene	1.96E-15
Chrysene	2.01E-15
Dibenzo(a,h)anthracene	1.99E-15
Fluorene	2.93E-15
Phenanthrene	4.87E-15
Pyrene	2.06E-15
Parathion	2.82E-19
Phenol	2.17E-12
Pyridine	2.01E-17
Quinoline	8.42E-17
Supona	2.26E-18
Trichlorobenzene	1.40E-17
Urea	3.10E-12
Vapona	1.82E-17
INORGANICS	
Aluminum	3.10E-09
Arsenic	6.16E-10
Barium	1.40E-10
Beryllium	5.84E-12
Boron	4.60E-09
Cadmium	1.68E-11
Calcium	2.45E-08
Chromium (III)	3.80E-11
Chromium (VI)	1.34E-12
Cobalt	1.26E-10
Copper	5.48E-07
Iron	7.61E-09
Lead	1.83E-10
Lithium	1.75E-11

Table 7A-4
(continued)

Manganese	2.27E-08
Molybdenum	1.76E-09
Phosphorus (total)	5.87E-07
Potassium	2.18E-07
Selenium	1.58E-06
Silicon	2.72E-08
Silver	1.62E-08
Sodium	1.86E-05
Strontium	5.84E-12
Tin	1.32E-09
Titanium	9.73E-12
Vanadium	3.73E-10
Yttrium	3.41E-12
Zinc	2.65E-09

Table 7A-5

Position Coefficients for Contaminants of Concern in Surface Water/Fish Ingestion Pathway

Pollutant	Partition Coefficient (Kp) (L/kg)
ORGANICS	
Acetonitrile	4.57E-01
Aldrin	2.51E+07
Atrazine	4.79E+02
Benzaldehyde	3.02E+01
Benzofuran	4.68E+02
Benzoic Acid	7.41E+01
Benzonitrile	3.63E+01
Biphenyl	1.45E+03
Carbazole	1.95E+03
4-Chlorobiphenyl	7.94E+04
4,4-Chlorobiphenyl	3.80E+05
4Chlorophenylmethylsulfone	1.58E+01
4-Chlorohpenylmethylsulfoxide	2.14E+01
p,p-DDE	4.90E+05
p,p-DDT	2.29E+06
Dibenzofuran	1.32E+04
Dieldrin	1.58E+06
Diisopropyl Methylphosphonate	5.37E+01
1,3-Dimethylbenzene	1.58E+03
Dimethyl Methylphosphonate	1.32E-02
Dimethylphosphate	1.32E-02
Dioxins/Furans (EPA TEFs)	1.26E+06
Dithiane	5.89E+00
Endrin	3.63E+04
Hexachlorobenzene	2.95E+05
Hexachlorocyclopentadiene	3.24E+05
Isodrin	3.24E+06
Malathion	7.76E+02
Methanol	1.51E-01
4-Nitrophenol	8.13E+02
PAHs	
Acenaphthalene	1.17E+04
Acenaphthene	8.32E+03
Benzo(a)pyrene	2.63E+06
Chrysene	6.17E+05
Dibenzo(a,h)anthracene	3.16E+06
Fluorene	2.40E+04
Phenanthrene	3.72E+04
Pyrene	1.51E+05
Parathion	6.46E+03
Phenol	2.88E+01
Pyridine	4.57E+00
Quinoline	1.07E+02
Supona	1.29E+03
Trichlorobenzene	9.55E+03
Urea	1.07E-03
Vapona	2.51E+01
INORGANICS	
Aluminum	9.00E+04
Arsenic	9.00E+04
Barium	4.00E+05
Beryllium	4.00E+05
Boron	9.00E+04
Cadmium	3.00E+05
Calcium	4.00E+05
Chromium (III)	4.00E+05
Chromium (VI)	4.00E+05
Cobalt	4.00E+05
Copper	2.00E+05
Iron	4.00E+05
Lead	2.00E+05
Lithium	4.00E+05
Manganese	4.00E+05

Table 7A-5
(continued)

Molybdenum	4.00E+05
Phosphorus (total)	9.00E+04
Potassium	4.00E+04
Selenium	9.00E+04
Silicon	9.00E+04
Silver	1.00E+05
Sodium	4.00E+05
Strontium	4.00E+05
Tin	2.00E+05
Titanium	4.00E+05
Vanadium	4.00E+05
Yttrium	4.00E+05
Zinc	2.00E+05

APPENDIX 7A

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APPENDIX 8A

DERIVATION OF SOIL POLLUTANT CONCENTRATIONS

APPENDIX 8A

DERIVATION OF SOIL POLLUTANT CONCENTRATIONS

This appendix presents a detailed discussion of the methods used to determine the soil pollutant concentrations. These values were used to determine exposure through the soil pathway.

Pollutant levels in soil were calculated for those pollutants, identified in Section 7, to be of concern through the soil pathway. They include semi-volatile organics and trace metals predicted to increase in the soil by 1 percent or more of the background concentration. Soil pollutant levels were calculated based on deposition over a 2-year period. It was assumed that trace metal pollutant levels in the soil are unaffected by degradation or other loss processes. For organics, degradation was evaluated only for those pollutants for which half-life data in soils were available. Thus, degradation through first order rate loss was calculated for atrazine, 4-chlorophenylmethylsulfone, 4-chlorophenylmethysulfoxide, DDE, DDT, diisopropyl methylphosphonate, dioxins/furans, endrin, hexachlorobenzene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, phenanthrene, and pyrene.

The equations used to calculate soil contaminant concentrations are as follows.

<u>No Degradation</u>

The formula for determining the maximum concentration of a pollutant in soil with no chemical degradation is:

$$C_{soil\text{-}max} = D_{total} \times \frac{1}{BD} \times \frac{1}{SD} \times T \times CF$$

Where:

$C_{soil\text{-}max}$ = Maximum pollutant concentration in soil due to deposition (mg/kg).

D_{total}	=	Total deposition rate ($g/m^2/yr$).
T	=	Accumulation time (2 years), life of incinerator.
CF	=	Conversion factor (1,000 mg/g).
SD	=	Mixing depth of soil (0.1 or 0.2 meters).
BD	=	Bulk density of soil (1,425 kg/m^3).

The soil bulk density, which was used (1,425 kg/m^3), was based on an average value from the various soil types that occur in the Rocky Mountain Arsenal vicinity (Price, 1990).

Average soil pollutant concentrations that would occur over the 70-year lifetime of an individual, assuming no chemical degradation, were calculated as follows:

$$C_{soil\text{-}avg} = \frac{2\ \text{years}}{70\ \text{years}} \quad \frac{C_{soil\text{-}max}}{2} + \frac{68\ \text{years}}{70\ \text{years}} \quad (C_{soil\text{-}max})$$

Where:

$C_{soil\text{-}avg}$ = Average pollutant concentration in soil due to deposition (mg/kg).

$C_{soil\text{-}max}$ = Maximum pollutant concentration in soil due to deposition (mg/kg).

The first term in this equation accounts for the two years of deposition, and the second term accounts for the years following the facility lifetime.

Degradation

The following equation was used to calculate the maximum concentration of a pollutant in soil, assuming that degradation is occurring:

$$C_{soil\text{-}max} = D_{total} \times \frac{1}{BD} \times \frac{1}{SD} \times \frac{(1-e^{-kT})}{k} \times CF$$

Where:

e = The base of the natural logarithms.
k = First order decay constant (yr^{-1}).

All other variables are as previously defined in this appendix.

The first order decay constant, k, was calculated as:

$$k = \ln(2)/\text{T-half}$$

Where:

ln(2) = 0.6931472
T-half = Chemical half-life in soil (yr).

- Atrazine = 0.5 years (Ebasco, 1990).
- 4-Chlorophenylmethylsulfone = 1 year (Ebasco, 1990).
- 4-Chlorophenylmethylsulfoxide = 1 year (Ebasco, 1990).
- DDE = 9 years (Ebasco, 1990).
- DDT = 9 years (Ebasco, 1990).
- Diisopropyl methylphosphonate = 2 years (Ebasco, 1990).
- Dimethyl methylphosphonate = 0.03397 years (Ebasco, 1990).
- Dioxins/Furans = 12 years (EPA, 1986a).
- Endrin = 10 years (Ebasco, 1990).
- Hexachlorobenzene = 6 years (EPA, 1986a).
- PAHs
    - Benzo(a)pyrene = 0.847 years (Park et al., 1990).
    - Chrysene = 1.06 years (Park et al., 1990).
    - Dibenzo(a,h)anthracene = 1.15 years (Park et al., 1990).
    - Fluoranthene = 1.03 years (Park et al., 1990).
    - Phenanthrene = 0.734 years (Park et al., 1990).
    - Pyrene = 0.712 years (Park et al., 1990).

An average soil concentration based on degradation was determined by calculating a soil concentration for every day over 70 years. For the 2 years of facility operation, it was assumed that each successive day would involve a new day's worth of deposition as well as the amount left over from the previous day after degradation. The first equation presented in this appendix was used to calculate a soil concentration for the first day of deposition by assuming T=1/365=2.74E-03. Degradation was calculated using the following equation:

$$C_T = C_o e^{-kT}$$

Where:

C_T = Concentration of organic in soil at day end (mg/kg).
C_o = Concentration of organic in soil at day start (mg/kg).
T = Time (2.74E-03 yr).

The concentration in soil left after the first day's degradation (C_T) was added to the amount of contaminant deposited on the second day. It was assumed that this process would continue each day over 2 years. The pollutant concentration at the end of year 2 represents the maximum soil concentration expected over the 70-year lifetime of an individual. The pollutants were assumed to continue to degrade from year 3 to the end of year 70 so that each successive day involves only the amount left after the previous day's degradation, without any new deposition occurring.

Soil concentrations for all pollutants of concern were calculated for each of the exposure scenarios (i.e., Resident-A, Resident-B, Farmer, Worker) based on total deposition rates specific to each receptor location. Based on the selection of the routes of exposure under the soil pathway, two mixing depths were used to calculate soil concentrations, 0.1 meter (10 cm) and 0.2 meter (20 cm).

Pollutant concentrations in soil determined for a 0.1-meter mixing depth were used in predicting exposure through the following routes of exposure:

- Exposure through child soil/dust ingestion.

- Exposure through child dermal absorption.
- Exposure through adult soil/dust ingestion.
- Exposure through adult dermal absorption.

For these exposure routes, the pollutants were assumed to be uniformly distributed in the top 0.1 meter of the soil.

Pollutant concentrations in soil established for a 0.2-meter mixing depth were used for the following routes of exposure:

- Exposure through vegetable consumption.
- Intake by cattle through grain, hay, and corn silage ingestion.

The 0.2-meter mixing depth was based on the assumption that only the top 0.2 meter (8 inches) of soil would be disturbed by diking or rototilling (EPA, 1986b).

For all pollutants, maximum soil concentrations were used in estimating potential noncarcinogenic effects. Average soil concentrations were used in calculating carcinogenic risk for children and adults, since the calculation of carcinogenic risk is based on a 70-year lifetime exposure. Since infants are exposed for only 1 year during which exposure concentrations will be at a maximum, maximum soil concentrations were used in the calculation of carcinogenic risk to the infant.

Tables 8A-1 through 8A-4 present the pollutant concentrations in soil based on the Resident-A, Resident-B, Farmer, and Worker scenarios, respectively. It should be noted that the soil concentrations calculated for the Farmer scenario also were used in the Resident-A and Resident-B scenarios in estimating pollutant uptake through milk and beef consumption.

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Table 8A-1

Soil Concentrations

Resident-A Scenario

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
ORGANICS					
Acetone	NA	NA	NA	NA	NA
Acetonitrile	8.22E-14	5.69E-13	5.77E-13	1.14E-12	1.15E-12
Acrylonitrile	NA	NA	NA	NA	NA
Aldrin	8.71E-16	6.03E-15	6.12E-15	1.21E-14	1.22E-14
Atrazine	1.94E-16	1.39E-17	4.57E-16	2.78E-17	9.14E-16
Benzaldehyde	1.78E-11	1.23E-10	1.25E-10	2.47E-10	2.51E-10
Benzene	NA	NA	NA	NA	NA
Benzofuran	3.43E-11	2.37E-10	2.40E-10	4.74E-10	4.81E-10
Benzoic Acid	8.64E-12	5.98E-11	6.07E-11	1.20E-10	1.21E-10
Benzonitrile	8.22E-15	5.69E-14	5.77E-14	1.14E-13	1.15E-13
Biphenyl	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbazole	1.64E-15	1.14E-14	1.15E-14	2.28E-14	2.31E-14
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
4-Chlorobiphenyl	9.94E-12	6.88E-11	6.98E-11	1.38E-10	1.40E-10
4,4-Chlorobiphenyl	1.30E-13	9.01E-13	9.14E-13	1.80E-12	1.83E-12
Chloroform	NA	NA	NA	NA	NA
4-Chlorophenylmethylsulfone	3.18E-15	4.58E-16	1.20E-14	9.15E-16	2.40E-14
4-Chlorophenylmethylsulfoxide	1.18E-14	1.70E-15	4.47E-14	3.41E-15	8.94E-14
p,p-DDE	1.45E-12	1.87E-12	9.39E-12	3.74E-12	1.88E-11
p,p-DDT	2.90E-16	3.75E-16	1.88E-15	7.49E-16	3.76E-15
Dibenzofuran	1.71E-12	1.18E-11	1.20E-11	2.37E-11	2.40E-11
Dichlorobenzenes (total)	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Dieldrin	1.79E-16	1.24E-15	1.26E-15	2.47E-15	2.51E-15
Diisopropyl Methylphosphonate	3.14E-14	9.06E-15	1.59E-13	1.81E-14	3.17E-13
1,3-Dimethylbenzene	3.43E-12	2.37E-11	2.40E-11	4.74E-11	4.81E-11
Dimethyldisulfide	NA	NA	NA	NA	NA
Dimethyl Methylphosphonate	7.49E-13	3.57E-15	1.25E-13	7.14E-15	2.50E-13
Dimethylphosphate	2.05E-13	1.42E-12	1.44E-12	2.84E-12	2.88E-12
Dioxins/Furans (EPA TEFs)	5.25E-13	8.91E-13	3.47E-12	1.78E-12	6.93E-12
Dithiane	3.14E-17	2.17E-16	2.21E-16	4.35E-16	4.41E-16
Endrin	1.74E-16	2.49E-16	1.14E-15	4.97E-16	2.27E-15
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobenzene	5.84E-14	5.05E-14	3.65E-13	1.01E-13	7.30E-13
Hexachlorocyclopentadiene	1.62E-15	1.12E-14	1.14E-14	2.24E-14	2.27E-14
Isodrin	4.58E-16	3.17E-15	3.22E-15	6.34E-15	6.44E-15
Malathion	7.00E-16	4.84E-15	4.91E-15	9.68E-15	9.82E-15
Methanol	1.99E-11	1.38E-10	1.40E-10	2.75E-10	2.79E-10
Methyl Chloride	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA
4-Nitrophenol	7.24E-15	5.01E-14	5.08E-14	1.00E-13	1.02E-13

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Table 8A-1
(continued)

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
PAHs					
Acenaphthalene	8.57E-12	5.93E-11	6.02E-11	1.19E-10	1.20E-10
Acenaphthene	8.57E-12	5.93E-11	6.02E-11	1.19E-10	1.20E-10
Benzo(a)pyrene	1.71E-12	2.09E-13	5.88E-12	4.17E-13	1.18E-11
Chrysene	1.71E-12	2.61E-13	6.67E-12	5.23E-13	1.33E-11
Dibenzo(a,h)anthracene	1.71E-12	2.84E-13	6.95E-12	5.67E-13	1.39E-11
Fluoranthene	5.14E-12	7.65E-13	1.98E-11	1.53E-12	3.96E-11
Fluorene	1.71E-12	1.18E-11	1.20E-11	2.37E-11	2.40E-11
Phenanthrene	3.43E-12	3.62E-13	1.08E-11	7.24E-13	2.15E-11
Pyrene	1.71E-12	1.76E-13	5.27E-12	3.51E-13	1.05E-11
Parathion	9.66E-17	6.68E-16	6.78E-16	1.34E-15	1.36E-15
Pentachlorobenzene	2.61E-14	1.81E-13	1.83E-13	3.62E-13	3.67E-13
Phenol	9.27E-11	6.42E-10	6.51E-10	1.28E-09	1.30E-09
Pyridine	NA	NA	NA	NA	NA
Quinoline	4.09E-15	2.83E-14	2.87E-14	5.67E-14	5.75E-14
Styrene	NA	NA	NA	NA	NA
Supona	2.90E-16	2.01E-15	2.04E-15	4.01E-15	4.07E-15
Tetrachlorobenzene	1.10E-14	7.63E-14	7.74E-14	1.53E-13	1.55E-13
Tetrachloroethene	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA
Trichlorobenzene	5.81E-15	4.02E-14	4.08E-14	8.04E-14	8.15E-14
Trichloroethene	NA	NA	NA	NA	NA
Urea	1.26E-10	8.69E-10	8.82E-10	1.74E-09	1.76E-09
Vapona	7.73E-16	5.35E-15	5.43E-15	1.07E-14	1.09E-14
Vinyl Chloride	NA	NA	NA	NA	NA
Xylene	NA	NA	NA	NA	NA
INORGANICS					
Aluminum	NA	NA	NA	NA	NA
Ammonia	NA	NA	NA	NA	NA
Antimony	7.98E-08	5.52E-07	5.60E-07	1.10E-06	1.12E-06
Arsenic	4.51E-07	3.12E-06	3.17E-06	6.25E-06	6.34E-06
Barium	1.11E-07	7.65E-07	7.76E-07	1.53E-06	1.55E-06
Beryllium	4.62E-09	3.20E-08	3.24E-08	6.39E-08	6.48E-08
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA
Chromium (III)	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA
Copper	4.23E-04	2.93E-03	2.97E-03	5.86E-03	5.94E-03
Cyanogen	NA	NA	NA	NA	NA
Hydrogen Cyanide	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA
Lead	1.42E-07	9.81E-07	9.95E-07	1.96E-06	1.99E-06
Lithium	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA

Table 8A-1
(continued)

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	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
Manganese	NA	NA	NA	NA	NA
Mercury	1.25E-07	8.64E-07	8.77E-07	1.73E-06	1.75E-06
Molybdenum	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA
Phosphate	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA
Selenium	1.16E-03	8.01E-03	8.13E-03	1.60E-02	1.63E-02
Silicon	NA	NA	NA	NA	NA
Silver	1.20E-05	8.30E-05	8.42E-05	1.66E-04	1.68E-04
Sodium	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA
Thallium	1.17E-06	8.06E-06	8.18E-06	1.61E-05	1.64E-05
Tin	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA
Yittrium	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA

Table 8A-2

Soil Concentrations

Resident-B Scenario

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	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
ORGANICS					
Acetone	NA	NA	NA	NA	NA
Acetonitrile	1.19E-13	8.23E-13	8.34E-13	1.65E-12	1.67E-12
Acrylonitrile	NA	NA	NA	NA	NA
Aldrin	1.26E-15	8.72E-15	8.84E-15	1.74E-14	1.77E-14
Atrazine	2.80E-16	2.01E-17	6.60E-16	4.03E-17	1.32E-15
Benzaldehyde	2.58E-11	1.79E-10	1.81E-10	3.57E-10	3.62E-10
Benzene	NA	NA	NA	NA	NA
Benzofuran	4.95E-11	3.43E-10	3.48E-10	6.85E-10	6.95E-10
Benzoic Acid	1.25E-11	8.65E-11	8.77E-11	1.73E-10	1.75E-10
Benzonitrile	1.19E-14	8.23E-14	8.34E-14	1.65E-13	1.67E-13
Biphenyl	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbazole	2.38E-15	1.65E-14	1.67E-14	3.29E-14	3.34E-14
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
4-Chlorobiphenyl	1.44E-11	9.94E-11	1.01E-10	1.99E-10	2.02E-10
4,4-Chlorobiphenyl	1.88E-13	1.30E-12	1.32E-12	2.60E-12	2.64E-12
Chloroform	NA	NA	NA	NA	NA
4-Chlorophenylmethylsulfone	4.59E-15	6.62E-16	1.74E-14	1.32E-15	3.47E-14
4-Chlorophenylmethylsulfoxide	1.71E-14	2.46E-15	6.46E-14	4.92E-15	1.29E-13
p,p-DDE	2.09E-12	2.70E-12	1.36E-11	5.41E-12	2.72E-11
p,p-DDT	4.19E-16	5.41E-16	2.72E-15	1.08E-15	5.44E-15
Dibenzofuran	2.47E-12	1.71E-11	1.74E-11	3.42E-11	3.47E-11
Dichlorobenzenes (total)	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Dieldrin	2.59E-16	1.79E-15	1.81E-15	3.58E-15	3.63E-15
Diisopropyl Methylphosphonate	4.54E-14	1.31E-14	2.29E-13	2.62E-14	4.58E-13
1,3-Dimethylbenzene	4.95E-12	3.43E-11	3.48E-11	6.85E-11	6.95E-11
Dimethyldisulfide	NA	NA	NA	NA	NA
Dimethyl Methylphosphonate	1.08E-12	5.16E-15	1.81E-13	1.03E-14	3.61E-13
Dimethylphosphate	2.97E-13	2.05E-12	2.08E-12	4.11E-12	4.17E-12
Dioxins/Furans (EPA TEFs)	7.59E-13	1.29E-12	5.01E-12	2.58E-12	1.00E-11
Dithiane	4.54E-17	3.14E-16	3.19E-16	6.29E-16	6.38E-16
Endrin	2.51E-16	3.59E-16	1.64E-15	7.19E-16	3.28E-15
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobenzene	8.45E-14	7.30E-14	5.28E-13	1.46E-13	1.06E-12
Hexachlorocyclopentadiene	2.34E-15	1.62E-14	1.64E-14	3.24E-14	3.29E-14
Isodrin	6.63E-16	4.59E-15	4.65E-15	9.17E-15	9.30E-15
Malathion	1.01E-15	7.00E-15	7.10E-15	1.40E-14	1.42E-14
Methanol	2.87E-11	1.99E-10	2.02E-10	3.98E-10	4.03E-10
Methyl Chloride	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA
4-Nitrophenol	1.05E-14	7.25E-14	7.35E-14	1.45E-13	1.47E-13

Table 8A-2
(continued)

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	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
PAHs					
Acenaphthalene	1.24E-11	8.58E-11	8.70E-11	1.72E-10	1.74E-10
Acenaphthene	1.24E-11	8.58E-11	8.70E-11	1.72E-10	1.74E-10
Benzo(a)pyrene	2.47E-12	3.01E-13	8.50E-12	6.03E-13	1.70E-11
Chrysene	2.47E-12	3.78E-13	9.64E-12	7.55E-13	1.93E-11
Dibenzo(a,h)anthracene	2.47E-12	4.10E-13	1.01E-11	8.20E-13	2.01E-11
Fluoranthene	7.44E-12	1.11E-12	2.86E-11	2.21E-12	5.72E-11
Fluorene	2.47E-12	1.71E-11	1.74E-11	3.42E-11	3.47E-11
Phenanthrene	4.95E-12	5.24E-13	1.56E-11	1.05E-12	3.11E-11
Pyrene	2.47E-12	2.54E-13	7.61E-12	5.07E-13	1.52E-11
Parathion	1.40E-16	9.66E-16	9.80E-16	1.93E-15	1.96E-15
Pentachlorobenzene	3.78E-14	2.61E-13	2.65E-13	5.23E-13	5.31E-13
Phenol	1.34E-10	9.28E-10	9.41E-10	1.86E-09	1.88E-09
Pyridine	NA	NA	NA	NA	NA
Quinoline	5.92E-15	4.10E-14	4.15E-14	8.19E-14	8.31E-14
Styrene	NA	NA	NA	NA	NA
Supona	4.19E-16	2.90E-15	2.94E-15	5.80E-15	5.89E-15
Tetrachlorobenzene	1.59E-14	1.10E-13	1.12E-13	2.21E-13	2.24E-13
Tetrachloroethene	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA
Trichlorobenzene	8.40E-15	5.81E-14	5.89E-14	1.16E-13	1.18E-13
Trichloroethene	NA	NA	NA	NA	NA
Urea	1.82E-10	1.26E-09	1.27E-09	2.51E-09	2.55E-09
Vapona	1.12E-15	7.74E-15	7.85E-15	1.55E-14	1.57E-14
Vinyl Chloride	NA	NA	NA	NA	NA
Xylene	NA	NA	NA	NA	NA
INORGANICS					
Aluminum	NA	NA	NA	NA	NA
Ammonia	NA	NA	NA	NA	NA
Antimony	1.15E-07	7.98E-07	8.10E-07	1.60E-06	1.62E-06
Arsenic	6.53E-07	4.52E-06	4.58E-06	9.03E-06	9.16E-06
Barium	1.60E-07	1.11E-06	1.12E-06	2.21E-06	2.24E-06
Beryllium	6.68E-09	4.62E-08	4.69E-08	9.24E-08	9.37E-08
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA
Chromium (III)	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA
Copper	6.12E-04	4.24E-03	4.30E-03	8.47E-03	8.59E-03
Cyanogen	NA	NA	NA	NA	NA
Hydrogen Cyanide	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA
Lead	2.05E-07	1.42E-06	1.44E-06	2.84E-06	2.88E-06
Lithium	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA

Table 8A-2
(continued)

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	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
Manganese	NA	NA	NA	NA	NA
Mercury	1.81E-07	1.25E-06	1.27E-06	2.50E-06	2.54E-06
Molybdenum	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA
Phosphate	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA
Selenium	1.67E-03	1.16E-02	1.18E-02	2.32E-02	2.35E-02
Silicon	NA	NA	NA	NA	NA
Silver	1.74E-05	1.20E-04	1.22E-04	2.40E-04	2.44E-04
Sodium	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA
Thallium	1.68E-06	1.17E-05	1.18E-05	2.33E-05	2.36E-05
Tin	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA
Yittrium	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA

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Table 8A-3

Soil Concentrations

Farmer Scenario

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
ORGANICS					
Acetone	NA	NA	NA	NA	NA
Acetonitrile	7.05E-14	4.88E-13	4.95E-13	9.75E-13	9.89E-13
Acrylonitrile	NA	NA	NA	NA	NA
Aldrin	7.47E-16	5.17E-15	5.24E-15	1.03E-14	1.05E-14
Atrazine	1.66E-16	1.19E-17	3.92E-16	2.39E-17	7.83E-16
Benzaldehyde	1.53E-11	1.06E-10	1.07E-10	2.12E-10	2.15E-10
Benzene	NA	NA	NA	NA	NA
Benzofuran	2.94E-11	2.03E-10	2.06E-10	4.06E-10	4.12E-10
Benzoic Acid	7.41E-12	5.13E-11	5.20E-11	1.03E-10	1.04E-10
Benzonitrile	7.05E-15	4.88E-14	4.95E-14	9.75E-14	9.89E-14
Biphenyl	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbazole	1.41E-15	9.75E-15	9.89E-15	1.95E-14	1.98E-14
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
4-Chlorobiphenyl	8.52E-12	5.89E-11	5.98E-11	1.18E-10	1.20E-10
4,4-Chlorobiphenyl	1.12E-13	7.72E-13	7.83E-13	1.54E-12	1.57E-12
Chloroform	NA	NA	NA	NA	NA
4-Chlorophenylmethylsulfone	2.72E-15	3.92E-16	1.03E-14	7.84E-16	2.06E-14
4-Chlorophenylmethylsulfoxide	1.01E-14	1.46E-15	3.83E-14	2.92E-15	7.66E-14
p,p-DDE	1.24E-12	1.60E-12	8.05E-12	3.21E-12	1.61E-11
p,p-DDT	2.49E-16	3.21E-16	1.61E-15	6.42E-16	3.22E-15
Dibenzofuran	1.47E-12	1.01E-11	1.03E-11	2.03E-11	2.06E-11
Dichlorobenzenes (total)	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Dieldrin	1.53E-16	1.06E-15	1.08E-15	2.12E-15	2.15E-15
Diisopropyl Methylphosphonate	2.69E-14	7.76E-15	1.36E-13	1.55E-14	2.72E-13
1,3-Dimethylbenzene	2.94E-12	2.03E-11	2.06E-11	4.06E-11	4.12E-11
Dimethyldisulfide	NA	NA	NA	NA	NA
Dimethyl Methylphosphonate	6.42E-13	3.06E-15	1.07E-13	6.12E-15	2.14E-13
Dimethylphosphate	1.76E-13	1.22E-12	1.24E-12	2.44E-12	2.47E-12
Dioxins/Furans (EPA TEFs)	4.50E-13	7.64E-13	2.97E-12	1.53E-12	5.94E-12
Dithiane	2.69E-17	1.86E-16	1.89E-16	3.73E-16	3.78E-16
Endrin	1.49E-16	2.13E-16	9.73E-16	4.26E-16	1.95E-15
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobenzene	5.01E-14	4.33E-14	3.13E-13	8.66E-14	6.26E-13
Hexachlorocyclopentadiene	1.39E-15	9.61E-15	9.75E-15	1.92E-14	1.95E-14
Isodrin	3.93E-16	2.72E-15	2.76E-15	5.44E-15	5.52E-15
Malathion	6.00E-16	4.15E-15	4.21E-15	8.30E-15	8.42E-15
Methanol	1.70E-11	1.18E-10	1.20E-10	2.36E-10	2.39E-10
Methyl Chloride	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA
4-Nitrophenol	6.21E-15	4.30E-14	4.36E-14	8.59E-14	8.72E-14

Table 8A-3
(continued)

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
PAHs					
Acenaphthalene	7.35E-12	5.08E-11	5.16E-11	1.02E-10	1.03E-10
Acenaphthene	7.35E-12	5.08E-11	5.16E-11	1.02E-10	1.03E-10
Benzo(a)pyrene	1.47E-12	1.79E-13	5.04E-12	3.58E-13	1.01E-11
Chrysene	1.47E-12	2.24E-13	5.72E-12	4.48E-13	1.14E-11
Dibenzo(a,h)anthracene	1.47E-12	2.43E-13	5.96E-12	4.86E-13	1.19E-11
Fluoranthene	4.41E-12	6.56E-13	1.70E-11	1.31E-12	3.39E-11
Fluorene	1.47E-12	1.01E-11	1.03E-11	2.03E-11	2.06E-11
Phenanthrene	2.94E-12	3.10E-13	9.22E-12	6.21E-13	1.84E-11
Pyrene	1.47E-12	1.50E-13	4.51E-12	3.01E-13	9.02E-12
Parathion	8.28E-17	5.73E-16	5.81E-16	1.15E-15	1.16E-15
Pentachlorobenzene	2.24E-14	1.55E-13	1.57E-13	3.10E-13	3.15E-13
Phenol	7.95E-11	5.50E-10	5.58E-10	1.10E-09	1.12E-09
Pyridine	NA	NA	NA	NA	NA
Quinoline	3.51E-15	2.43E-14	2.46E-14	4.86E-14	4.93E-14
Styrene	NA	NA	NA	NA	NA
Supona	2.49E-16	1.72E-15	1.75E-15	3.44E-15	3.49E-15
Tetrachlorobenzene	9.45E-15	6.54E-14	6.63E-14	1.31E-13	1.33E-13
Tetrachloroethene	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA
Trichlorobenzene	4.98E-15	3.44E-14	3.49E-14	6.89E-14	6.99E-14
Trichloroethene	NA	NA	NA	NA	NA
Urea	1.08E-10	7.45E-10	7.56E-10	1.49E-09	1.51E-09
Vapona	6.63E-16	4.59E-15	4.65E-15	9.17E-15	9.31E-15
Vinyl Chloride	NA	NA	NA	NA	NA
Xylene	NA	NA	NA	NA	NA
INORGANICS					
Aluminum	NA	NA	NA	NA	NA
Ammonia	NA	NA	NA	NA	NA
Antimony	6.84E-08	4.73E-07	4.80E-07	9.46E-07	9.60E-07
Arsenic	3.87E-07	2.68E-06	2.72E-06	5.35E-06	5.43E-06
Barium	9.48E-08	6.56E-07	6.65E-07	1.31E-06	1.33E-06
Beryllium	3.96E-09	2.74E-08	2.78E-08	5.48E-08	5.56E-08
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA
Chromium (III)	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA
Copper	3.63E-04	2.51E-03	2.55E-03	5.02E-03	5.09E-03
Cyanogen	NA	NA	NA	NA	NA
Hydrogen Cyanide	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA
Lead	1.21E-07	8.40E-07	8.53E-07	1.68E-06	1.71E-06
Lithium	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA

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Table 8A-3
(continued)

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
Manganese	NA	NA	NA	NA	NA
Mercury	1.07E-07	7.41E-07	7.52E-07	1.48E-06	1.50E-06
Molybdenum	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA
Phosphate	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA
Selenium	9.93E-04	6.87E-03	6.97E-03	1.37E-02	1.39E-02
Silicon	NA	NA	NA	NA	NA
Silver	1.03E-05	7.12E-05	7.22E-05	1.42E-04	1.44E-04
Sodium	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA
Thallium	9.99E-07	6.91E-06	7.01E-06	1.38E-05	1.40E-05
Tin	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA
Yttrium	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA

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Table 8A-4

Soil Concentrations

Worker Scenario

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
ORGANICS					
Acetone	NA	NA	NA	NA	NA
Acetonitrile	1.08E-13	7.46E-13	7.57E-13	1.49E-12	1.51E-12
Acrylonitrile	NA	NA	NA	NA	NA
Aldrin	1.14E-15	7.91E-15	8.02E-15	1.58E-14	1.60E-14
Atrazine	2.54E-16	1.83E-17	5.99E-16	3.65E-17	1.20E-15
Benzaldehyde	2.34E-11	1.62E-10	1.64E-10	3.24E-10	3.29E-10
Benzene	NA	NA	NA	NA	NA
Benzofuran	4.49E-11	3.11E-10	3.15E-10	6.22E-10	6.31E-10
Benzoic Acid	1.13E-11	7.84E-11	7.96E-11	1.57E-10	1.59E-10
Benzonitrile	1.08E-14	7.46E-14	7.57E-14	1.49E-13	1.51E-13
Biphenyl	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbazole	2.16E-15	1.49E-14	1.51E-14	2.98E-14	3.03E-14
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
4-Chlorobiphenyl	1.30E-11	9.02E-11	9.15E-11	1.80E-10	1.83E-10
4,4-Chlorobiphenyl	1.71E-13	1.18E-12	1.20E-12	2.36E-12	2.40E-12
Chloroform	NA	NA	NA	NA	NA
4-Chlorophenylmethylsulfone	4.17E-15	6.00E-16	1.57E-14	1.20E-15	3.15E-14
4-Chlorophenylmethylsulfoxide	1.55E-14	2.23E-15	5.86E-14	4.47E-15	1.17E-13
p,p-DDE	1.90E-12	2.45E-12	1.23E-11	4.90E-12	2.46E-11
p,p-DDT	3.81E-16	4.91E-16	2.47E-15	9.82E-16	4.93E-15
Dibenzofuran	2.24E-12	1.55E-11	1.58E-11	3.11E-11	3.15E-11
Dichlorobenzenes (total)	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloroethene	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Dieldrin	2.35E-16	1.62E-15	1.65E-15	3.24E-15	3.29E-15
Diisopropyl Methylphosphonate	4.12E-14	1.19E-14	2.08E-13	2.37E-14	4.16E-13
1,3-Dimethylbenzene	4.49E-12	3.11E-11	3.15E-11	6.22E-11	6.31E-11
Dimethyldisulfide	NA	NA	NA	NA	NA
Dimethyl Methylphosphonate	9.82E-13	4.68E-15	1.64E-13	9.36E-15	3.28E-13
Dimethylphosphate	2.69E-13	1.86E-12	1.89E-12	3.73E-12	3.78E-12
Dioxins/Furans (EPA TEFs)	6.89E-13	1.17E-12	4.55E-12	2.34E-12	9.09E-12
Dithiane	4.12E-17	2.85E-16	2.89E-16	5.70E-16	5.79E-16
Endrin	2.28E-16	3.26E-16	1.49E-15	6.52E-16	2.98E-15
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobenzene	7.67E-14	6.62E-14	4.79E-13	1.32E-13	9.57E-13
Hexachlorocyclopentadiene	2.13E-15	1.47E-14	1.49E-14	2.94E-14	2.98E-14
Isodrin	6.01E-16	4.16E-15	4.22E-15	8.32E-15	8.44E-15
Malathion	9.18E-16	6.35E-15	6.44E-15	1.27E-14	1.29E-14
Methanol	2.61E-11	1.80E-10	1.83E-10	3.61E-10	3.66E-10
Methyl Chloride	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA
4-Nitrophenol	9.50E-15	6.57E-14	6.67E-14	1.31E-13	1.33E-13

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Table 8A-4
(continued)

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
PAHs					
Acenaphthalene	1.12E-11	7.78E-11	7.89E-11	1.56E-10	1.58E-10
Acenaphthene	1.12E-11	7.78E-11	7.89E-11	1.56E-10	1.58E-10
Benzo(a)pyrene	2.24E-12	2.74E-13	7.71E-12	5.47E-13	1.54E-11
Chrysene	2.24E-12	3.43E-13	8.75E-12	6.85E-13	1.75E-11
Dibenzo(a,h)anthracene	2.24E-12	3.72E-13	9.12E-12	7.44E-13	1.82E-11
Fluoranthene	6.75E-12	1.00E-12	2.59E-11	2.01E-12	5.19E-11
Fluorene	2.24E-12	1.55E-11	1.58E-11	3.11E-11	3.15E-11
Phenanthrene	4.49E-12	4.75E-13	1.41E-11	9.50E-13	2.82E-11
Pyrene	2.24E-12	2.30E-13	6.91E-12	4.60E-13	1.38E-11
Parathion	1.27E-16	8.76E-16	8.89E-16	1.75E-15	1.78E-15
Pentachlorobenzene	3.43E-14	2.37E-13	2.41E-13	4.74E-13	4.81E-13
Phenol	1.22E-10	8.41E-10	8.54E-10	1.68E-09	1.71E-09
Pyridine	NA	NA	NA	NA	NA
Quinoline	5.37E-15	3.71E-14	3.77E-14	7.43E-14	7.54E-14
Styrene	NA	NA	NA	NA	NA
Supona	3.81E-16	2.63E-15	2.67E-15	5.26E-15	5.34E-15
Tetrachlorobenzene	1.45E-14	1.00E-13	1.01E-13	2.00E-13	2.03E-13
Tetrachloroethene	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA
Trichlorobenzene	7.62E-15	5.27E-14	5.35E-14	1.05E-13	1.07E-13
Trichloroethene	NA	NA	NA	NA	NA
Urea	1.65E-10	1.14E-09	1.16E-09	2.28E-09	2.31E-09
Vapona	1.01E-15	7.02E-15	7.12E-15	1.40E-14	1.42E-14
Vinyl Chloride	NA	NA	NA	NA	NA
Xylene	NA	NA	NA	NA	NA
INORGANICS					
Aluminum	NA	NA	NA	NA	NA
Ammonia	NA	NA	NA	NA	NA
Antimony	1.05E-07	7.24E-07	7.34E-07	1.45E-06	1.47E-06
Arsenic	5.92E-07	4.10E-06	4.16E-06	8.19E-06	8.31E-06
Barium	1.45E-07	1.00E-06	1.02E-06	2.01E-06	2.04E-06
Beryllium	6.06E-09	4.19E-08	4.25E-08	8.38E-08	8.50E-08
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA
Chromium (III)	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA
Copper	5.55E-04	3.84E-03	3.90E-03	7.68E-03	7.79E-03
Cyanogen	NA	NA	NA	NA	NA
Hydrogen Cyanide	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA
Lead	1.86E-07	1.29E-06	1.30E-06	2.57E-06	2.61E-06
Lithium	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA

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Table 8A-4
(continued)

	TOTAL DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg
Manganese	NA	NA	NA	NA	NA
Mercury	1.64E-07	1.13E-06	1.15E-06	2.27E-06	2.30E-06
Molybdenum	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA
Phosphate	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA
Selenium	1.52E-03	1.05E-02	1.07E-02	2.10E-02	2.13E-02
Silicon	NA	NA	NA	NA	NA
Silver	1.57E-05	1.09E-04	1.10E-04	2.18E-04	2.21E-04
Sodium	NA	NA	NA	NA	NA
Strontium	NA	NA	NA	NA	NA
Thallium	1.53E-06	1.06E-05	1.07E-05	2.11E-05	2.15E-05
Tin	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA
Yittrium	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA

APPENDIX 8A

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APPENDIX 8B

METHODOLOGY FOR CALCULATING POLLUTANT CONCENTRATIONS IN VEGETABLES

APPENDIX 8B

METHODOLOGY FOR CALCULATING POLLUTANT CONCENTRATIONS IN VEGETABLES

This appendix presents a detailed discussion of the methods used to determine the pollutant concentrations in vegetables that are considered in the vegetable consumption exposure route. Three vegetables (carrots, lettuce, and tomatoes) were selected to represent the vegetables that may be grown in a household garden in the area surrounding the Rocky Mountain Arsenal.

8B.1 CARROTS

8B.1.1 General Approach

The pollutant concentration (C_u) in carrots resulting from uptake from the soil is expressed by the following equation:

$$C_u \text{ (mg/kg)} = \text{Pollutant concentration in soil (mg/kg)} \times \text{RUF}$$

Where:

RUF = Root uptake factor (unitless)

The soil concentrations used in the calculations are presented in Tables 8A-1, 8A-2, and 8A-3 for the Resident-A, Resident-B, and Farmer scenarios, respectively. The derivation of the root uptake factors is described in the following subsection.

8B.1.2 Derivation of Root Uptake Factors for Carrots

Organics

Root uptake factors (RUFs) were derived based on the work by Briggs et al. (1982). Briggs et al. (1982) studied the uptake of organic chemicals from solution by barley shoots and established the following relationship between the root concentration factor (RCF) and the K_{ow} (octanol/water partition coefficient) for the organics tested:

$$\log (RCF - 0.82) = 0.77 \log K_{ow} - 1.52$$

Where:

$RCF = C_{root}/C_{solution}$
C_{root} = Pollutant concentration in the root (mg/kg).
$C_{solution}$ = Pollutant concentration in water (mg/L).

Given the following relationship between pollutant distributions in soil and water phases:

$$\frac{C_{soil}}{C_{solution}} = (K_{oc})(f_{oc})$$

Where:

C_{soil} = Pollutant concentration in soil (mg/kg).
$C_{solution}$ = Pollutant concentration in water (mg/L).
K_{oc} = Organic carbon partition coefficient.
f_{oc} = Fraction of organic carbon in the soil, 1.42 percent (Price, 1990).

The RUF for each compound could be determined from the RCF as shown in the following equation:

$$RUF = \frac{RCF}{(K_{oc})(f_{oc})} = \frac{C_{root}/C_{solution}}{C_{soil}/C_{solution}} = \frac{C_{root}}{C_{soil}}$$

RCFs and RUFs were calculated for the pollutants of concern using K_{ow}s and K_{oc}s from EPA (1986) and a soil organic carbon content (f_{oc}) of 1.42 percent (Price, 1990). Log K_{ow} and K_{oc} values used in the calculation of RUFs are presented in Table 8B-1. K_{oc} data were not available for several chemicals. In these instances, the values were calculated based on the log K_{ow}. If the chemical was an aromatic with a log K_{ow} between 2 to 6.6, the following equation was used:

$\log K_{oc} = 0.937 \log K_{ow} - 0.006$ (Lymn et al., 1982)

For aromatics with a log K_{ow} falling outside the given range, as well as all other organic substances, the following equation was used:

$\log K_{oc} = 0.544 \log K_{ow} + 1.377$ (Lyman et al., 1982).

<u>Inorganics</u>

The RUFs used for the inorganic compounds were based on transfer coefficients developed by Baes et al. (1984) for tubers. Tubers are similar to carrots in that most tubers grow underground and serve as food storage organs. The transfer coefficients, which are expressed as dry weight plant concentrations divided by dry weight soil concentrations, were converted to wet weight by assuming a water content for carrots of 88 percent (Baes et al., 1984).

RUFs used to determine inorganic uptake by carrots can be found in Tables 8B-2 through 8B-7. It should be noted that, although the chemical composition of a plant reflects its

Table 8B-1

Log K_{ow}s and K_{oc}s

Organic Compounds	Log K_{ow}	Source	K_{oc}	Source
Acetonitrile	-3.40E-01	EPA, 1986	2.20E+00	EPA, 1986
Aldrin	7.40E+00	EPA, 1989	9.60E+04	EPA, 1986
Atrazine	2.68E+00	EPA, 1987	3.20E+02	Calculated (a)
Benzaldehyde	1.48E+00	Verschueren, 1983	1.52E+02	Calculated (b)
Benzofuran	2.67E+00	Verschueren, 1983	3.13E+02	Calculated (a)
Benzoic Acid	1.87E+00	Verschueren, 1983	2.48E+02	Calculated (b)
Benzonitrile	1.56E+00	Verschueren, 1983	1.68E+02	Calculated (b)
Carbazole	3.29E+00	Verschueren, 1983	1.19E+03	Calculated (a)
4-Chlorobiphenyl	4.90E+00	EPA, 1987	3.85E+04	Calculated (a)
4,4-Chlorobiphenyl	5.58E+00	EPA, 1987	1.67E+05	Calculated (a)
4-Chlorophenylmethylsulfone	1.20E+00	Ebasco, 1990	1.26E+02	Ebasco, 1990
4-Chlorophenylmethylsulfoxide	1.33E+00	Ebasco, 1990	1.07E+02	Ebasco, 1990
p,p-DDE	5.69E+00	EPA, 1989	4.40E+06	EPA, 1989
p,p-DDT	6.36E+00	EPA, 1989	2.43E+05	EPA, 1989
Dibenzofuran	4.12E+00	HSDB, 1990	7.15E+03	Calculated (a)
Dieldrin	6.20E+00	EPA, 1989	1.70E+03	EPA, 1986

(a) Calculated using log K_{oc} = 0.937 log K_{ow}-0.006 (Lyman et al., 1982).
(b) Calculated using log K_{oc} = 0.544 log K_{ow} + 1.377 (Lyman et al., 1982).
(c) NTA = Not available

Table 8B-1
(continued)

Organic Compounds	Log K_{ow}	Source	K_{oc}	Source
Diisopropyl Methlphosphonate	1.73E+00	Ebasco, 1990	2.08E+02	Ebasco, 1990
1,3-Dimethylbenzene	3.20E+00	Verschueren, 1983	9.83E+02	Calculated (a)
Dimethyl Methylphosphonate	-1.88E+00	Ebasco, 1990	2.30E+00	Calculated (b)
Dimethylphosphate	NTA (c)	---	NTA (c)	---
Dioxins/Furans (EPA TEFs)	6.10E+00	EPA, 1989	3.30E+06	EPA, 1986
Dithiane	7.70E-01	Ebasco, 1990	6.20E+01	Calculated (b)
Endrin	4.56E+00	EPA, 1989	5.60E+06	Verschueren, 1983
Hexachlorobenzene	5.47E+00	EPA, 1989	5.00E+04	Howard, 1989
Hexachlorocyclopentadiene	5.51E+00	EPA, 1989	4.80E+03	EPA, 1986
Isodrin	6.51E+00	Ebasco, 1990	5.80E+03	Ebasco, 1990
Malathion	2.89E+00	EPA, 1987	1.80E+03	Ebasco, 1990
Methanol	-8.20E-01	Verschueren, 1983	8.50E+00	Calculated (b)
4-Nitrophenol	2.91E+00	EPA, 1989	5.26E+02	Calculated (a)
PAHs				
Acenaphthalene	4.07E+00	EPA, 1989	2.50E+03	EPA, 1986
Acenaphthene	3.92E+00	EPA, 1989	4.60E+03	EPA, 1986
Benzo(a)pyrene	6.42E+00	EPA, 1989	5.50E+06	EPA, 1986

(a) Calculated using log K_{oc} = 0.937 log K_{ow}-0.006 (Lyman et al., 1982).
(b) Calculated using log K_{oc} = 0.544 log K_{ow} + 1.377 (Lyman et al., 1982).
(c) NTA = Not available

Table 8B-1
(continued)

Organic Compounds	Log K_{ow}	Source	K_{oc}	Source
Chrysene	5.79E+00	EPA, 1989	2.00E+05	EPA, 1986
Dibenzo(a,h)anthracene	6.50E+00	EPA, 1989	3.30E+06	EPA, 1986
Fluoranthene	5.22E+00	EPA, 1989	3.80E+04	EPA, 1986
Fluorene	4.38E+00	EPA, 1989	7.30E+03	EPA, 1986
Phenanthrene	4.57E+00	EPA, 1989	1.40E+04	EPA, 1986
Pyrene	5.18E+00	EPA, 1989	3.80E+04	EPA, 1986
Parathion	3.81E+00	EPA, 1987	3.66E+03	Calculated (a)
Pentachlorobenzene	5.08E+00	EPA, 1987	1.30E+04	EPA, 1986
Phenol	1.46E+00	EPA, 1989	1.40E+01	EPA, 1986
Quinoline	2.03E+00	Verschueren, 1983	7.90E+01	Calculated (a)
Supona	3.11E+00	Ebasco, 1990	1.17E+03	Ebasco, 1990
Tetrachlorobenzene	4.37E+00	EPA, 1987	1.60E+03	EPA, 1986
Trichlorobenzene	3.98E+00	EPA, 1989	9.20E+03	EPA, 1986
Urea	-2.97E+00	Verschueren, 1983	5.80E-01	Calculated (b)
Vapona	1.40E+00	Ebasco, 1990	1.38E+02	Calculated (b)

(a) Calculated using log K_{oc} = 0.937 log K_{ow}-0.006 (Lyman et al., 1982).
(b) Calculated using log K_{oc} = 0.544 log K_{ow}+1.377 (Lyman et al., 1982).
(c) NTA = Not available

Table 8B-2

Average Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Resident-A Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	5.69E-13	-0.34	2.2	2.68E+01	1.52E-11	1.48E-15	2.21E-15
Aldrin	6.03E-15	7.4	96000	1.11E+01	6.66E-14	6.46E-18	9.67E-18
Atrazine	1.39E-17	2.68	320	9.50E-01	1.32E-17	1.28E-21	1.92E-21
Benzaldehyde	1.23E-10	1.48	152	5.73E-01	7.07E-11	6.86E-15	1.03E-14
Benzofuran	2.37E-10	2.67	313	9.57E-01	2.27E-10	2.20E-14	3.29E-14
Benzoic Acid	5.98E-11	1.87	248	4.69E-01	2.80E-11	2.72E-15	4.07E-15
Benzonitrile	5.69E-14	1.56	168	5.45E-01	3.10E-14	3.01E-18	4.50E-18
Carbazole	1.14E-14	3.29	1193	6.57E-01	7.48E-15	7.25E-19	1.09E-18
4-Chlorobiphenyl	6.88E-11	4.9	38486	3.29E-01	2.26E-11	2.19E-15	3.29E-15
4,4-Chlorobiphenyl	9.01E-13	5.58	166901	2.53E-01	2.28E-13	2.21E-17	3.30E-17
4-Chlorophenylmethylsulfone	4.58E-16	1.2	126	6.00E-01	2.75E-16	2.66E-20	3.99E-20
4-Chlorophenylmethylsulfoxide	1.70E-15	1.33	107	7.50E-01	1.28E-15	1.24E-19	1.85E-19
p,p-DDE	1.87E-12	5.69	4400000	1.16E-02	2.18E-14	2.11E-18	3.16E-18
p,p-DDT	3.75E-16	6.36	243000	6.91E-01	2.59E-16	2.51E-20	3.76E-20
Dibenzofuran	1.18E-11	4.12	7152	4.50E-01	5.33E-12	5.17E-16	7.74E-16
Dieldrin	1.24E-15	6.2	1700	7.44E+01	9.20E-14	8.92E-18	1.34E-17
Diisopropyl Methylphosphonate	9.06E-15	1.73	208	4.97E-01	4.50E-15	4.37E-19	6.54E-19
1,3-Dimethylbenzene	2.37E-11	3.2	983	6.88E-01	1.63E-11	1.58E-15	2.37E-15
Dimethyl Methylphosphonate	3.57E-15	-1.88	2.3	2.51E+01	8.97E-14	8.70E-18	1.30E-17
Dimethylphosphate	1.42E-12						
Dioxins/Furans (EPA TEFs)	8.91E-13	6.10E+00	3.30E+06	3.21E-02	2.86E-14	2.77E-18	4.15E-18
Dithiane	2.17E-16	0.77	62	1.07E+00	2.32E-16	2.25E-20	3.36E-20
Endrin	2.49E-16	4.56	5600000	1.24E-03	3.09E-19	3.00E-23	4.49E-23
Hexachlorobenzene	5.05E-14	5.47	50000	6.94E-01	3.51E-14	3.40E-18	5.09E-18
Hexachlorocyclopentadiene	1.12E-14	5.51	4800	7.76E+00	8.70E-14	8.43E-18	1.26E-17
Isodrin	3.17E-15	6.51	5800	3.78E+01	1.20E-13	1.16E-17	1.74E-17
Malathion	4.84E-15	2.89	1800	2.31E-01	1.12E-15	1.08E-19	1.62E-19
Methanol	1.38E-10	-0.82	8.5	6.85E+00	9.42E-10	9.13E-14	1.37E-13
4-Nitrophenol	5.01E-14	2.91	526	8.14E-01	4.08E-14	3.95E-18	5.92E-18
PAHs							
Acenaphthalene	5.93E-11	4.07	2500	1.18E+00	7.01E-11	6.79E-15	1.02E-14
Acenaphthene	5.93E-11	3.92	4600	4.95E-01	2.94E-11	2.85E-15	4.26E-15
Benzo(a)pyrene	2.09E-13	6.42	5500000	3.40E-02	7.09E-15	6.87E-19	1.03E-18
Chrysene	2.61E-13	5.79	200000	3.06E-01	7.99E-14	7.75E-18	1.16E-17
Dibenzo(a,h)anthracene	2.84E-13	6.5	3300000	6.52E-02	1.85E-14	1.79E-18	2.69E-18
Fluoranthene	7.65E-13	5.22	38000	5.87E-01	4.49E-13	4.35E-17	6.52E-17
Fluorene	1.18E-11	4.38	7300	6.95E-01	8.23E-12	7.98E-16	1.19E-15
Phenanthrene	3.62E-13	4.57	14000	5.06E-01	1.83E-13	1.78E-17	2.66E-17
Pyrene	1.76E-13	5.18	38000	5.47E-01	9.59E-14	9.30E-18	1.39E-17
Parathion	6.68E-16	3.81	3664	5.14E-01	3.43E-16	3.33E-20	4.99E-20
Pentachlorobenzene	1.81E-13	5.08	13000	1.34E+00	2.42E-13	2.35E-17	3.52E-17
Phenol	6.42E-10	1.46	14	6.15E+00	3.94E-09	3.82E-13	5.73E-13
Quinoline	2.83E-14	2.03	79	1.72E+00	4.86E-14	4.71E-18	7.05E-18

Table 8B-2
(continued)

Supona	2.01E-15	3.11	1172	5.00E-01	1.00E-15	9.72E-20	1.46E-19
Tetrachlorobenzene	7.63E-14	4.37	1600	3.12E+00	2.38E-13	2.30E-17	3.45E-17
Trichlorobenzene	4.02E-14	3.98	9200	2.75E-01	1.10E-14	1.07E-18	1.60E-18
Urea	8.69E-10	-2.97	0.58	9.96E+01	8.66E-08	8.39E-12	1.26E-11
Vapona	5.35E-15	1.4	138	6.03E-01	3.23E-15	3.13E-19	4.68E-19
INORGANICS							
Antimony	5.52E-07			3.60E-03	1.99E-09	1.93E-13	2.89E-13
Arsenic	3.12E-06			7.20E-04	2.25E-09	2.18E-13	3.26E-13
Barium	7.65E-07			1.80E-03	1.38E-09	1.33E-13	2.00E-13
Beryllium	3.20E-08			1.80E-04	5.75E-12	5.58E-16	8.35E-16
Copper	2.93E-03			3.00E-02	8.79E-05	8.52E-09	1.28E-08
Lead	9.81E-07			1.08E-03	1.06E-09	1.03E-13	1.54E-13
Mercury	8.64E-07			2.40E-02	2.07E-08	2.01E-12	3.01E-12
Selenium	8.01E-03			3.00E-03	2.40E-05	2.33E-09	3.49E-09
Silver	8.30E-05			1.20E-02	9.97E-07	9.66E-11	1.45E-10
Thallium	8.06E-06			4.80E-05	3.87E-10	3.75E-14	5.62E-14

Table 8B-3

Average Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Resident-B Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	AVERAGE CONC. DUE TO UPTAKE mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	8.23E-13	-0.34	2.2	2.68E+01	2.20E-11	2.14E-15	3.20E-15
Aldrin	8.72E-15	7.4	96000	1.11E+01	9.63E-14	9.34E-18	1.40E-17
Atrazine	2.01E-17	2.68	320	9.50E-01	1.91E-17	1.85E-21	2.77E-21
Benzaldehyde	1.79E-10	1.48	152	5.73E-01	1.02E-10	9.91E-15	1.48E-14
Benzofuran	3.43E-10	2.67	313	9.57E-01	3.28E-10	3.18E-14	4.76E-14
Benzoic Acid	8.65E-11	1.87	248	4.69E-01	4.05E-11	3.93E-15	5.89E-15
Benzonitrile	8.23E-14	1.56	168	5.45E-01	4.48E-14	4.35E-18	6.51E-18
Carbazole	1.65E-14	3.29	1193	6.57E-01	1.08E-14	1.05E-18	1.57E-18
4-Chlorobiphenyl	9.94E-11	4.9	38486	3.29E-01	3.27E-11	3.17E-15	4.75E-15
4,4-Chlorobiphenyl	1.30E-12	5.58	166901	2.53E-01	3.29E-13	3.19E-17	4.78E-17
4-Chlorophenylmethylsulfone	6.62E-16	1.2	126	6.00E-01	3.97E-16	3.85E-20	5.76E-20
4-Chlorophenylmethylsulfoxide	2.46E-15	1.33	107	7.50E-01	1.85E-15	1.79E-19	2.68E-19
p,p-DDE	2.70E-12	5.69	4400000	1.16E-02	3.15E-14	3.05E-18	4.57E-18
p,p-DDT	5.41E-16	6.36	243000	6.91E-01	3.74E-16	3.63E-20	5.43E-20
Dibenzofuran	1.71E-11	4.12	7152	4.50E-01	7.71E-12	7.47E-16	1.12E-15
Dieldrin	1.79E-15	6.2	1700	7.44E+01	1.33E-13	1.29E-17	1.93E-17
Diisopropyl Methylphosphonate	1.31E-14	1.73	208	4.97E-01	6.51E-15	6.31E-19	9.45E-19
1,3-Dimethylbenzene	3.43E-11	3.2	983	6.88E-01	2.36E-11	2.29E-15	3.43E-15
Dimethyl Methylphosphonate	5.16E-15	-1.88	2.3	2.51E+01	1.30E-13	1.26E-17	1.88E-17
Dimethylphosphate	2.05E-12						
Dioxins/Furans (EPA TEFs)	1.29E-12	6.10E+00	3.30E+06	3.21E-02	4.13E-14	4.01E-18	6.00E-18
Dithiane	3.14E-16	0.77	62	1.07E+00	3.35E-16	3.25E-20	4.86E-20
Endrin	3.59E-16	4.56	5600000	1.24E-03	4.47E-19	4.33E-23	6.48E-23
Hexachlorobenzene	7.30E-14	5.47	50000	6.94E-01	5.07E-14	4.91E-18	7.36E-18
Hexachlorocyclopentadiene	1.62E-14	5.51	4800	7.76E+00	1.26E-13	1.22E-17	1.83E-17
Isodrin	4.59E-15	6.51	5800	3.78E+01	1.73E-13	1.68E-17	2.51E-17
Malathion	7.00E-15	2.89	1800	2.31E-01	1.61E-15	1.56E-19	2.34E-19
Methanol	1.99E-10	-0.82	8.5	6.85E+00	1.36E-09	1.32E-13	1.98E-13
4-Nitrophenol	7.25E-14	2.91	526	8.14E-01	5.89E-14	5.71E-18	8.56E-18
PAHs							
Acenaphthalene	8.58E-11	4.07	2500	1.18E+00	1.01E-10	9.82E-15	1.47E-14
Acenaphthene	8.58E-11	3.92	4600	4.95E-01	4.24E-11	4.11E-15	6.16E-15
Benzo(a)pyrene	3.01E-13	6.42	5500000	3.40E-02	1.02E-14	9.92E-19	1.49E-18
Chrysene	3.78E-13	5.79	200000	3.06E-01	1.15E-13	1.12E-17	1.68E-17
Dibenzo(a,h)anthracene	4.10E-13	6.5	3300000	6.52E-02	2.67E-14	2.59E-18	3.88E-18
Fluoranthene	1.11E-12	5.22	38000	5.87E-01	6.49E-13	6.29E-17	9.42E-17
Fluorene	1.71E-11	4.38	7300	6.95E-01	1.19E-11	1.15E-15	1.73E-15
Phenanthrene	5.24E-13	4.57	14000	5.06E-01	2.65E-13	2.57E-17	3.84E-17
Pyrene	2.54E-13	5.18	38000	5.47E-01	1.39E-13	1.34E-17	2.01E-17
Parathion	9.66E-16	3.81	3664	5.14E-01	4.97E-16	4.81E-20	7.21E-20
Pentachlorobenzene	2.61E-13	5.08	13000	1.34E+00	3.50E-13	3.39E-17	5.08E-17
Phenol	9.28E-10	1.46	14	6.15E+00	5.70E-09	5.53E-13	8.28E-13
Quinoline	4.10E-14	2.03	79	1.72E+00	7.02E-14	6.81E-18	1.02E-17

Table 8B-3
(continued)

DRAFT

Supona	2.90E-15	3.11	1172	5.00E-01	1.45E-15	1.41E-19	2.10E-19
Tetrachlorobenzene	1.10E-13	4.37	1600	3.12E+00	3.44E-13	3.33E-17	4.99E-17
Trichlorobenzene	5.81E-14	3.98	9200	2.75E-01	1.60E-14	1.55E-18	2.32E-18
Urea	1.26E-09	-2.97	0.58	9.96E+01	1.25E-07	1.21E-11	1.82E-11
Vapona	7.74E-15	1.4	138	6.03E-01	4.66E-15	4.52E-19	6.77E-19
INORGANICS							
Antimony	7.98E-07			3.60E-03	2.87E-09	2.79E-13	4.17E-13
Arsenic	4.52E-06			7.20E-04	3.25E-09	3.15E-13	4.72E-13
Barium	1.11E-06			1.80E-03	1.99E-09	1.93E-13	2.89E-13
Beryllium	4.62E-08			1.80E-04	8.32E-12	8.06E-16	1.21E-15
Copper	4.24E-03			3.00E-02	1.27E-04	1.23E-08	1.84E-08
Lead	1.42E-06			1.08E-03	1.53E-09	1.48E-13	2.22E-13
Mercury	1.25E-06			2.40E-02	3.00E-08	2.91E-12	4.35E-12
Selenium	1.16E-02			3.00E-03	3.48E-05	3.37E-09	5.05E-09
Silver	1.20E-04			1.20E-02	1.44E-06	1.40E-10	2.09E-10
Thallium	1.17E-05			4.80E-05	5.59E-10	5.42E-14	8.12E-14

Table 8B-4

Average Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Farmer Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	4.88E-13	-0.34	2.2	2.68E+01	1.31E-11	1.10E-14	2.36E-14
Aldrin	5.17E-15	7.4	96000	1.11E+01	5.71E-14	4.79E-17	1.03E-16
Atrazine	1.19E-17	2.68	320	9.50E-01	1.13E-17	9.51E-21	2.05E-20
Benzaldehyde	1.06E-10	1.48	152	5.73E-01	6.06E-11	5.09E-14	1.09E-13
Benzofuran	2.03E-10	2.67	313	9.57E-01	1.94E-10	1.63E-13	3.51E-13
Benzoic Acid	5.13E-11	1.87	248	4.69E-01	2.40E-11	2.02E-14	4.34E-14
Benzonitrile	4.88E-14	1.56	168	5.45E-01	2.66E-14	2.23E-17	4.80E-17
Carbazole	9.75E-15	3.29	1193	6.57E-01	6.41E-15	5.38E-18	1.16E-17
4-Chlorobiphenyl	5.89E-11	4.9	38486	3.29E-01	1.94E-11	1.63E-14	3.50E-14
4,4-Chlorobiphenyl	7.72E-13	5.58	166901	2.53E-01	1.95E-13	1.64E-16	3.52E-16
4-Chlorophenylmethylsulfone	3.92E-16	1.2	126	6.00E-01	2.35E-16	1.98E-19	4.25E-19
4-Chlorophenylmethylsulfoxide	1.46E-15	1.33	107	7.50E-01	1.09E-15	9.19E-19	1.98E-18
p,p-DDE	1.60E-12	5.69	4400000	1.16E-02	1.87E-14	1.57E-17	3.37E-17
p,p-DDT	3.21E-16	6.36	243000	6.91E-01	2.22E-16	1.86E-19	4.01E-19
Dibenzofuran	1.01E-11	4.12	7152	4.50E-01	4.57E-12	3.84E-15	8.25E-15
Dieldrin	1.06E-15	6.2	1700	7.44E+01	7.89E-14	6.62E-17	1.42E-16
Diisopropyl Methylphosphonate	7.76E-15	1.73	208	4.97E-01	3.86E-15	3.24E-18	6.97E-18
1,3-Dimethylbenzene	2.03E-11	3.2	983	6.88E-01	1.40E-11	1.17E-14	2.53E-14
Dimethyl Methylphosphonate	3.06E-15	-1.88	2.3	2.51E+01	7.69E-14	6.46E-17	1.39E-16
Dimethylphosphate	1.22E-12						
Dioxins/Furans (EPA TEFs)	7.64E-13	6.10E+00	3.30E+06	3.21E-02	2.45E-14	2.06E-17	4.43E-17
Dithiane	1.86E-16	0.77	62	1.07E+00	1.99E-16	1.67E-19	3.59E-19
Endrin	2.13E-16	4.56	5600000	1.24E-03	2.65E-19	2.22E-22	4.78E-22
Hexachlorobenzene	4.33E-14	5.47	50000	6.94E-01	3.01E-14	2.52E-17	5.43E-17
Hexachlorocyclopentadiene	9.61E-15	5.51	4800	7.76E+00	7.46E-14	6.26E-17	1.35E-16
Isodrin	2.72E-15	6.51	5800	3.78E+01	1.03E-13	8.62E-17	1.85E-16
Malathion	4.15E-15	2.89	1800	2.31E-01	9.57E-16	8.03E-19	1.73E-18
Methanol	1.18E-10	-0.82	8.5	6.85E+00	8.08E-10	6.78E-13	1.46E-12
4-Nitrophenol	4.30E-14	2.91	526	8.14E-01	3.49E-14	2.93E-17	6.31E-17
PAHs							
Acenaphthalene	5.08E-11	4.07	2500	1.18E+00	6.00E-11	5.04E-14	1.08E-13
Acenaphthene	5.08E-11	3.92	4600	4.95E-01	2.52E-11	2.11E-14	4.54E-14
Benzo(a)pyrene	1.79E-13	6.42	5500000	3.40E-02	6.07E-15	5.10E-18	1.10E-17
Chrysene	2.24E-13	5.79	200000	3.06E-01	6.85E-14	5.75E-17	1.24E-16
Dibenzo(a,h)anthracene	2.43E-13	6.5	3300000	6.52E-02	1.59E-14	1.33E-17	2.86E-17
Fluoranthene	6.56E-13	5.22	38000	5.87E-01	3.85E-13	3.23E-16	6.95E-16
Fluorene	1.01E-11	4.38	7300	6.95E-01	7.05E-12	5.92E-15	1.27E-14
Phenanthrene	3.10E-13	4.57	14000	5.06E-01	1.57E-13	1.32E-16	2.84E-16
Pyrene	1.50E-13	5.18	38000	5.47E-01	8.22E-14	6.90E-17	1.48E-16
Parathion	5.73E-16	3.81	3664	5.14E-01	2.94E-16	2.47E-19	5.32E-19
Pentachlorobenzene	1.55E-13	5.08	13000	1.34E+00	2.08E-13	1.74E-16	3.75E-16
Phenol	5.50E-10	1.46	14	6.15E+00	3.38E-09	2.84E-12	6.10E-12
Quinoline	2.43E-14	2.03	79	1.72E+00	4.16E-14	3.50E-17	7.52E-17

Table 8B-4
(continued)

Supona	1.72E-15	3.11	1172	5.00E-01	8.59E-16	7.22E-19	1.55E-18
Tetrachlorobenzene	6.54E-14	4.37	1600	3.12E+00	2.04E-13	1.71E-16	3.68E-16
Trichlorobenzene	3.44E-14	3.98	9200	2.75E-01	9.46E-15	7.94E-18	1.71E-17
Urea	7.45E-10	-2.97	0.58	9.96E+01	7.42E-08	6.23E-11	1.34E-10
Vapona	4.59E-15	1.4	138	6.03E-01	2.76E-15	2.32E-18	4.99E-18
INORGANICS							
Antimony	4.73E-07			3.60E-03	1.70E-09	1.43E-12	3.08E-12
Arsenic	2.68E-06			7.20E-04	1.93E-09	1.62E-12	3.48E-12
Barium	6.56E-07			1.80E-03	1.18E-09	9.91E-13	2.13E-12
Beryllium	2.74E-08			1.80E-04	4.93E-12	4.14E-15	8.90E-15
Copper	2.51E-03			3.00E-02	7.53E-05	6.32E-08	1.36E-07
Lead	8.40E-07			1.08E-03	9.08E-10	7.62E-13	1.64E-12
Mercury	7.41E-07			2.40E-02	1.78E-08	1.49E-11	3.21E-11
Selenium	6.87E-03			3.00E-03	2.06E-05	1.73E-08	3.72E-08
Silver	7.12E-05			1.20E-02	8.54E-07	7.17E-10	1.54E-09
Thallium	6.91E-06			4.80E-05	3.32E-10	2.78E-13	5.99E-13

Table 8B-5

Maximum Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Resident-A Location

	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	MAXIMUM CONC.DUE TO UPTAKE mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	5.77E-13	-3.40E-01	2.20E+00	2.68E+01	1.55E-11	1.50E-15	2.24E-15
Aldrin	6.12E-15	7.40E+00	9.60E+04	1.11E+01	6.76E-14	6.55E-18	9.81E-18
Atrazine	4.57E-16	2.68E+00	3.20E+02	9.50E-01	4.34E-16	4.21E-20	6.30E-20
Benzaldehyde	1.25E-10	1.48E+00	1.52E+02	5.73E-01	7.18E-11	6.96E-15	1.04E-14
Benzofuran	2.40E-10	2.67E+00	3.13E+02	9.57E-01	2.30E-10	2.23E-14	3.34E-14
Benzoic Acid	6.07E-11	1.87E+00	2.48E+02	4.69E-01	2.85E-11	2.76E-15	4.13E-15
Benzonitrile	5.77E-14	1.56E+00	1.68E+02	5.45E-01	3.15E-14	3.05E-18	4.57E-18
Carbazole	1.15E-14	3.29E+00	1.19E+03	6.57E-01	7.59E-15	7.35E-19	1.10E-18
4-Chlorobiphenyl	6.98E-11	4.90E+00	3.85E+04	3.29E-01	2.30E-11	2.23E-15	3.33E-15
4,4-Chlorobiphenyl	9.14E-13	5.58E+00	1.67E+05	2.53E-01	2.31E-13	2.24E-17	3.35E-17
4-Chlorophenylmethylsulfone	1.20E-14	1.20E+00	1.26E+02	6.00E-01	7.21E-15	6.99E-19	1.05E-18
4-Chlorophenylmethylsulfoxide	4.47E-14	1.33E+00	1.07E+02	7.50E-01	3.35E-14	3.25E-18	4.87E-18
p,p-DDE	9.39E-12	5.69E+00	4.40E+06	1.16E-02	1.09E-13	1.06E-17	1.59E-17
p,p-DDT	1.88E-15	6.36E+00	2.43E+05	6.91E-01	1.30E-15	1.26E-19	1.89E-19
Dibenzofuran	1.20E-11	4.12E+00	7.15E+03	4.50E-01	5.41E-12	5.24E-16	7.85E-16
Dieldrin	1.26E-15	6.20E+00	1.70E+03	7.44E+01	9.34E-14	9.05E-18	1.36E-17
Diisopropyl Methylphosphonate	1.59E-13	1.73E+00	2.08E+02	4.97E-01	7.88E-14	7.64E-18	1.14E-17
1,3-Dimethylbenzene	2.40E-11	3.20E+00	9.83E+02	6.88E-01	1.66E-11	1.60E-15	2.40E-15
Dimethyl Methylphosphonate	1.25E-13	-1.88E+00	2.30E+00	2.51E+01	3.14E-12	3.04E-16	4.56E-16
Dimethylphosphate	1.44E-12						
Dioxins/Furans (EPA TEFs)	3.47E-12	6.10E+00	3.30E+06	3.21E-02	1.11E-13	1.08E-17	1.62E-17
Dithiane	2.21E-16	7.70E-01	6.20E+01	1.07E+00	2.35E-16	2.28E-20	3.41E-20
Endrin	1.14E-15	4.56E+00	5.60E+06	1.24E-03	1.41E-18	1.37E-22	2.05E-22
Hexachlorobenzene	3.65E-13	5.47E+00	5.00E+04	6.94E-01	2.53E-13	2.46E-17	3.68E-17
Hexachlorocyclopentadiene	1.14E-14	5.51E+00	4.80E+03	7.76E+00	8.82E-14	8.55E-18	1.28E-17
Isodrin	3.22E-15	6.51E+00	5.80E+03	3.78E+01	1.22E-13	1.18E-17	1.76E-17
Malathion	4.91E-15	2.89E+00	1.80E+03	2.31E-01	1.13E-15	1.10E-19	1.64E-19
Methanol	1.40E-10	-8.20E-01	8.50E+00	6.85E+00	9.56E-10	9.27E-14	1.39E-13
4-Nitrophenol	5.08E-14	2.91E+00	5.26E+02	8.14E-01	4.14E-14	4.01E-18	6.01E-18
PAHs							
Acenaphthalene	6.02E-11	4.07E+00	2.50E+03	1.18E+00	7.11E-11	6.89E-15	1.03E-14
Acenaphthene	6.02E-11	3.92E+00	4.60E+03	4.95E-01	2.98E-11	2.89E-15	4.32E-15
Benzo(a)pyrene	5.88E-12	6.42E+00	5.50E+06	3.40E-02	2.00E-13	1.94E-17	2.90E-17
Chrysene	6.67E-12	5.79E+00	2.00E+05	3.06E-01	2.04E-12	1.98E-16	2.96E-16
Dibenzo(a,h)anthracene	6.95E-12	6.50E+00	3.30E+06	6.52E-02	4.53E-13	4.40E-17	6.58E-17
Fluoranthene	1.98E-11	5.22E+00	3.80E+04	5.87E-01	1.16E-11	1.13E-15	1.69E-15
Fluorene	1.20E-11	4.38E+00	7.30E+03	6.95E-01	8.35E-12	8.09E-16	1.21E-15
Phenanthrene	1.08E-11	4.57E+00	1.40E+04	5.06E-01	5.44E-12	5.27E-16	7.90E-16
Pyrene	5.27E-12	5.18E+00	3.80E+04	5.47E-01	2.88E-12	2.79E-16	4.18E-16
Parathion	6.78E-16	3.81E+00	3.66E+03	5.14E-01	3.48E-16	3.38E-20	5.06E-20
Pentachlorobenzene	1.83E-13	5.08E+00	1.30E+04	1.34E+00	2.46E-13	2.38E-17	3.57E-17
Phenol	6.51E-10	1.46E+00	1.40E+01	6.15E+00	4.00E-09	3.88E-13	5.81E-13
Quinoline	2.87E-14	2.03E+00	7.90E+01	1.72E+00	4.93E-14	4.78E-18	7.16E-18

Table 8B-5
(continued)

Supona	2.04E-15	3.11E+00	1.17E+03	5.00E-01	1.02E-15	9.86E-20	1.48E-19
Tetrachlorobenzene	7.74E-14	4.37E+00	1.60E+03	3.12E+00	2.41E-13	2.34E-17	3.50E-17
Trichlorobenzene	4.08E-14	3.98E+00	9.20E+03	2.75E-01	1.12E-14	1.09E-18	1.63E-18
Urea	8.82E-10	-2.97E+00	5.80E-01	9.96E+01	8.78E-08	8.51E-12	1.27E-11
Vapona	5.43E-15	1.40E+00	1.38E+02	6.03E-01	3.27E-15	3.17E-19	4.75E-19
INORGANICS							
Antimony	5.60E-07			3.60E-03	2.02E-09	1.95E-13	2.93E-13
Arsenic	3.17E-06			7.20E-04	2.28E-09	2.21E-13	3.31E-13
Barium	7.76E-07			1.80E-03	1.40E-09	1.35E-13	2.03E-13
Beryllium	3.24E-08			1.80E-04	5.84E-12	5.66E-16	8.47E-16
Copper	2.97E-03			3.00E-02	8.92E-05	8.64E-09	1.29E-08
Lead	9.95E-07			1.08E-03	1.07E-09	1.04E-13	1.56E-13
Mercury	8.77E-07			2.40E-02	2.10E-08	2.04E-12	3.06E-12
Selenium	8.13E-03			3.00E-03	2.44E-05	2.36E-09	3.54E-09
Silver	8.42E-05			1.20E-02	1.01E-06	9.80E-11	1.47E-10
Thallium	8.18E-06			4.80E-05	3.93E-10	3.81E-14	5.70E-14

Table 8B-6

Maximum Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Resident-B Location

	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	8.34E-13	-3.40E-01	2.20E+00	2.68E+01	2.23E-11	2.17E-15	3.24E-15
Aldrin	8.84E-15	7.40E+00	9.60E+04	1.11E+01	9.77E-14	9.47E-18	1.42E-17
Atrazine	6.60E-16	2.68E+00	3.20E+02	9.50E-01	6.27E-16	6.08E-20	9.11E-20
Benzaldehyde	1.81E-10	1.48E+00	1.52E+02	5.73E-01	1.04E-10	1.01E-14	1.51E-14
Benzofuran	3.48E-10	2.67E+00	3.13E+02	9.57E-01	3.33E-10	3.23E-14	4.83E-14
Benzoic Acid	8.77E-11	1.87E+00	2.48E+02	4.69E-01	4.11E-11	3.99E-15	5.97E-15
Benzonitrile	8.34E-14	1.56E+00	1.68E+02	5.45E-01	4.55E-14	4.41E-18	6.60E-18
Carbazole	1.67E-14	3.29E+00	1.19E+03	6.57E-01	1.10E-14	1.06E-18	1.59E-18
4-Chlorobiphenyl	1.01E-10	4.90E+00	3.85E+04	3.29E-01	3.32E-11	3.22E-15	4.82E-15
4,4-Chlorobiphenyl	1.32E-12	5.58E+00	1.67E+05	2.53E-01	3.34E-13	3.23E-17	4.84E-17
4-Chlorophenylmethylsulfone	1.74E-14	1.20E+00	1.26E+02	6.00E-01	1.04E-14	1.01E-18	1.51E-18
4-Chlorophenylmethylsulfoxide	6.46E-14	1.33E+00	1.07E+02	7.50E-01	4.85E-14	4.70E-18	7.04E-18
p,p-DDE	1.36E-11	5.69E+00	4.40E+06	1.16E-02	1.58E-13	1.53E-17	2.30E-17
p,p-DDT	2.72E-15	6.36E+00	2.43E+05	6.91E-01	1.88E-15	1.82E-19	2.73E-19
Dibenzofuran	1.74E-11	4.12E+00	7.15E+03	4.50E-01	7.82E-12	7.58E-16	1.14E-15
Dieldrin	1.81E-15	6.20E+00	1.70E+03	7.44E+01	1.35E-13	1.31E-17	1.96E-17
Diisopropyl Methylphosphonate	2.29E-13	1.73E+00	2.08E+02	4.97E-01	1.14E-13	1.10E-17	1.65E-17
1,3-Dimethylbenzene	3.48E-11	3.20E+00	9.83E+02	6.88E-01	2.39E-11	2.32E-15	3.47E-15
Dimethyl Methylphosphonate	1.81E-13	-1.88E+00	2.30E+00	2.51E+01	4.54E-12	4.40E-16	6.59E-16
Dimethylphosphate	2.08E-12						
Dioxins/Furans (EPA TEFs)	5.01E-12	6.10E+00	3.30E+06	3.21E-02	1.61E-13	1.56E-17	2.34E-17
Dithiane	3.19E-16	7.70E-01	6.20E+01	1.07E+00	3.40E-16	3.29E-20	4.93E-20
Endrin	1.64E-15	4.56E+00	5.60E+06	1.24E-03	2.04E-18	1.98E-22	2.96E-22
Hexachlorobenzene	5.28E-13	5.47E+00	5.00E+04	6.94E-01	3.66E-13	3.55E-17	5.32E-17
Hexachlorocyclopentadiene	1.64E-14	5.51E+00	4.80E+03	7.76E+00	1.28E-13	1.24E-17	1.85E-17
Isodrin	4.65E-15	6.51E+00	5.80E+03	3.78E+01	1.76E-13	1.70E-17	2.55E-17
Malathion	7.10E-15	2.89E+00	1.80E+03	2.31E-01	1.64E-15	1.59E-19	2.38E-19
Methanol	2.02E-10	-8.20E-01	8.50E+00	6.85E+00	1.38E-09	1.34E-13	2.01E-13
4-Nitrophenol	7.35E-14	2.91E+00	5.26E+02	8.14E-01	5.98E-14	5.80E-18	8.68E-18
PAHs							
Acenaphthalene	8.70E-11	4.07E+00	2.50E+03	1.18E+00	1.03E-10	9.96E-15	1.49E-14
Acenaphthene	8.70E-11	3.92E+00	4.60E+03	4.95E-01	4.31E-11	4.17E-15	6.25E-15
Benzo(a)pyrene	8.50E-12	6.42E+00	5.50E+06	3.40E-02	2.89E-13	2.80E-17	4.19E-17
Chrysene	9.64E-12	5.79E+00	2.00E+05	3.06E-01	2.95E-12	2.86E-16	4.28E-16
Dibenzo(a,h)anthracene	1.01E-11	6.50E+00	3.30E+06	6.52E-02	6.55E-13	6.35E-17	9.51E-17
Fluoranthene	2.86E-11	5.22E+00	3.80E+04	5.87E-01	1.68E-11	1.63E-15	2.44E-15
Fluorene	1.74E-11	4.38E+00	7.30E+03	6.95E-01	1.21E-11	1.17E-15	1.75E-15
Phenanthrene	1.56E-11	4.57E+00	1.40E+04	5.06E-01	7.87E-12	7.63E-16	1.14E-15
Pyrene	7.61E-12	5.18E+00	3.80E+04	5.47E-01	4.16E-12	4.03E-16	6.04E-16
Parathion	9.80E-16	3.81E+00	3.66E+03	5.14E-01	5.04E-16	4.88E-20	7.31E-20
Pentachlorobenzene	2.65E-13	5.08E+00	1.30E+04	1.34E+00	3.55E-13	3.44E-17	5.16E-17
Phenol	9.41E-10	1.46E+00	1.40E+01	6.15E+00	5.78E-09	5.61E-13	8.40E-13
Quinoline	4.15E-14	2.03E+00	7.90E+01	1.72E+00	7.13E-14	6.91E-18	1.03E-17

Table 8B-6
(continued)

Supona	2.94E-15	3.11E+00	1.17E+03	5.00E-01	1.47E-15	1.43E-19	2.14E-19
Tetrachlorobenzene	1.12E-13	4.37E+00	1.60E+03	3.12E+00	3.48E-13	3.38E-17	5.06E-17
Trichlorobenzene	5.89E-14	3.98E+00	9.20E+03	2.75E-01	1.62E-14	1.57E-18	2.35E-18
Urea	1.27E-09	-2.97E+00	5.80E-01	9.96E+01	1.27E-07	1.23E-11	1.84E-11
Vapona	7.85E-15	1.40E+00	1.38E+02	6.03E-01	4.73E-15	4.59E-19	6.87E-19
INORGANICS							
Antimony	8.10E-07			3.60E-03	2.91E-09	2.83E-13	4.23E-13
Arsenic	4.58E-06			7.20E-04	3.30E-09	3.20E-13	4.79E-13
Barium	1.12E-06			1.80E-03	2.02E-09	1.96E-13	2.93E-13
Beryllium	4.69E-08			1.80E-04	8.44E-12	8.18E-16	1.22E-15
Copper	4.30E-03			3.00E-02	1.29E-04	1.25E-08	1.87E-08
Lead	1.44E-06			1.08E-03	1.55E-09	1.51E-13	2.25E-13
Mercury	1.27E-06			2.40E-02	3.04E-08	2.95E-12	4.42E-12
Selenium	1.18E-02			3.00E-03	3.53E-05	3.42E-09	5.12E-09
Silver	1.22E-04			1.20E-02	1.46E-06	1.42E-10	2.12E-10
Thallium	1.18E-05			4.80E-05	5.68E-10	5.50E-14	8.24E-14

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Table 8B-7

Maximum Pollutant Concentration in Carrots, and Adult and Child Daily Intake at the Farmer Location

	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	log Kow	Koc	ROOT UPTAKE FACTOR	MAXIMUM CONC.DUE TO UPTAKE mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	4.95E-13	-3.40E-01	2.20E+00	2.68E+01	1.32E-11	1.11E-14	2.39E-14
Aldrin	5.24E-15	7.40E+00	9.60E+04	1.11E+01	5.79E-14	4.86E-17	1.05E-16
Atrazine	3.92E-16	2.68E+00	3.20E+02	9.50E-01	3.72E-16	3.12E-19	6.72E-19
Benzaldehyde	1.07E-10	1.48E+00	1.52E+02	5.73E-01	6.15E-11	5.16E-14	1.11E-13
Benzofuran	2.06E-10	2.67E+00	3.13E+02	9.57E-01	1.97E-10	1.66E-13	3.56E-13
Benzoic Acid	5.20E-11	1.87E+00	2.48E+02	4.69E-01	2.44E-11	2.05E-14	4.40E-14
Benzonitrile	4.95E-14	1.56E+00	1.68E+02	5.45E-01	2.70E-14	2.26E-17	4.87E-17
Carbazole	9.89E-15	3.29E+00	1.19E+03	6.57E-01	6.50E-15	5.46E-18	1.17E-17
4-Chlorobiphenyl	5.98E-11	4.90E+00	3.85E+04	3.29E-01	1.97E-11	1.65E-14	3.55E-14
4,4-Chlorobiphenyl	7.83E-13	5.58E+00	1.67E+05	2.53E-01	1.98E-13	1.66E-16	3.57E-16
4-Chlorophenylmethylsulfone	1.03E-14	1.20E+00	1.26E+02	6.00E-01	6.18E-15	5.19E-18	1.12E-17
4-Chlorophenylmethylsulfoxide	3.83E-14	1.33E+00	1.07E+02	7.50E-01	2.87E-14	2.41E-17	5.19E-17
p,p-DDE	8.05E-12	5.69E+00	4.40E+06	1.16E-02	9.37E-14	7.87E-17	1.69E-16
p,p-DDT	1.61E-15	6.36E+00	2.43E+05	6.91E-01	1.11E-15	9.35E-19	2.01E-18
Dibenzofuran	1.03E-11	4.12E+00	7.15E+03	4.50E-01	4.64E-12	3.89E-15	8.37E-15
Dieldrin	1.08E-15	6.20E+00	1.70E+03	7.44E+01	8.00E-14	6.72E-17	1.44E-16
Diisopropyl Methylphosphonate	1.36E-13	1.73E+00	2.08E+02	4.97E-01	6.75E-14	5.67E-17	1.22E-16
1,3-Dimethylbenzene	2.06E-11	3.20E+00	9.83E+02	6.88E-01	1.42E-11	1.19E-14	2.56E-14
Dimethyl Methylphosphonate	1.07E-13	-1.88E+00	2.30E+00	2.51E+01	2.69E-12	2.26E-15	4.86E-15
Dimethylphosphate	1.24E-12						
Dioxins/Furans (EPA TEFs)	2.97E-12	6.10E+00	3.30E+06	3.21E-02	9.54E-14	8.01E-17	1.72E-16
Dithiane	1.89E-16	7.70E-01	6.20E+01	1.07E+00	2.01E-16	1.69E-19	3.64E-19
Endrin	9.73E-16	4.56E+00	5.60E+06	1.24E-03	1.21E-18	1.02E-21	2.18E-21
Hexachlorobenzene	3.13E-13	5.47E+00	5.00E+04	6.94E-01	2.17E-13	1.82E-16	3.92E-16
Hexachlorocyclopentadiene	9.75E-15	5.51E+00	4.80E+03	7.76E+00	7.56E-14	6.35E-17	1.37E-16
Isodrin	2.76E-15	6.51E+00	5.80E+03	3.78E+01	1.04E-13	8.74E-17	1.88E-16
Malathion	4.21E-15	2.89E+00	1.80E+03	2.31E-01	9.71E-16	8.15E-19	1.75E-18
Methanol	1.20E-10	-8.20E-01	8.50E+00	6.85E+00	8.19E-10	6.88E-13	1.48E-12
4-Nitrophenol	4.36E-14	2.91E+00	5.26E+02	8.14E-01	3.55E-14	2.98E-17	6.40E-17
PAHs							
Acenaphthalene	5.16E-11	4.07E+00	2.50E+03	1.18E+00	6.09E-11	5.11E-14	1.10E-13
Acenaphthene	5.16E-11	3.92E+00	4.60E+03	4.95E-01	2.55E-11	2.14E-14	4.61E-14
Benzo(a)pyrene	5.04E-12	6.42E+00	5.50E+06	3.40E-02	1.71E-13	1.44E-16	3.09E-16
Chrysene	5.72E-12	5.79E+00	2.00E+05	3.06E-01	1.75E-12	1.47E-15	3.16E-15
Dibenzo(a,h)anthracene	5.96E-12	6.50E+00	3.30E+06	6.52E-02	3.89E-13	3.26E-16	7.02E-16
Fluoranthene	1.70E-11	5.22E+00	3.80E+04	5.87E-01	9.95E-12	8.35E-15	1.80E-14
Fluorene	1.03E-11	4.38E+00	7.30E+03	6.95E-01	7.15E-12	6.01E-15	1.29E-14
Phenanthrene	9.22E-12	4.57E+00	1.40E+04	5.06E-01	4.66E-12	3.92E-15	8.42E-15
Pyrene	4.51E-12	5.18E+00	3.80E+04	5.47E-01	2.47E-12	2.07E-15	4.45E-15
Parathion	5.81E-16	3.81E+00	3.66E+03	5.14E-01	2.99E-16	2.51E-19	5.39E-19
Pentachlorobenzene	1.57E-13	5.08E+00	1.30E+04	1.34E+00	2.11E-13	1.77E-16	3.80E-16
Phenol	5.58E-10	1.46E+00	1.40E+01	6.15E+00	3.43E-09	2.88E-12	6.19E-12
Quinoline	2.46E-14	2.03E+00	7.90E+01	1.72E+00	4.23E-14	3.55E-17	7.63E-17

Table 8B-7
(continued)

Supona	1.75E-15	3.11E+00	1.17E+03	5.00E-01	8.72E-16	7.32E-19	1.57E-18
Tetrachlorobenzene	6.63E-14	4.37E+00	1.60E+03	3.12E+00	2.07E-13	1.73E-16	3.73E-16
Trichlorobenzene	3.49E-14	3.98E+00	9.20E+03	2.75E-01	9.59E-15	8.05E-18	1.73E-17
Urea	7.56E-10	-2.97E+00	5.80E-01	9.96E+01	7.53E-08	6.32E-11	1.36E-10
Vapona	4.65E-15	1.40E+00	1.38E+02	6.03E-01	2.80E-15	2.35E-18	5.07E-18
INORGANICS							
Antimony	4.80E-07			3.60E-03	1.73E-09	1.45E-12	3.12E-12
Arsenic	2.72E-06			7.20E-04	1.96E-09	1.64E-12	3.53E-12
Barium	6.65E-07			1.80E-03	1.20E-09	1.01E-12	2.16E-12
Beryllium	2.78E-08			1.80E-04	5.00E-12	4.20E-15	9.03E-15
Copper	2.55E-03			3.00E-02	7.64E-05	6.42E-08	1.38E-07
Lead	8.53E-07			1.08E-03	9.21E-10	7.73E-13	1.66E-12
Mercury	7.52E-07			2.40E-02	1.80E-08	1.51E-11	3.26E-11
Selenium	6.97E-03			3.00E-03	2.09E-05	1.76E-08	3.78E-08
Silver	7.22E-05			1.20E-02	8.67E-07	7.28E-10	1.56E-09
Thallium	7.01E-06			4.80E-05	3.37E-10	2.83E-13	6.08E-13

growth medium, the rate of metals uptake by plants is highly variable and is influenced by many factors. These factors include parameters specific to the plant (species, age) and to the properties of the soil (pH, organic content, cation exchange capacity, concentration of other inorganics, temperature, aeration). Thus, in the absence of specific information regarding garden soil characteristics in the RMA area, the calculated RUFs should be viewed as best approximations.

Average concentrations of pollutants in carrots and average daily intakes are summarized for the adult and child for the Resident-A, Resident-B, and Farmer scenarios in Tables 8B-2, 8B-3, and 8B-4, respectively. The maximum pollutant concentration in carrots and the maximum daily intakes are summarized in Tables 8B-5, 8B-6, and 8B-7.

8B.2 TOMATOES AND LETTUCE

8B.2.1 Surface Deposition of Pollutants on Tomatoes and Lettuce

The plant pollutant concentration resulting from surface deposition (C_d) is expressed by the equation:

$$C_d \text{ (maximum)} = (DR)\ (VSDF)$$

$$C_d \text{ (average)} = (DR)\ (VSDF)\ (2/70)$$

Where:

DR = Pollutant dry deposition rate (mg/m^2s). This includes only dry deposition. Pollutants falling on plant surfaces from wet deposition are washed off the plant and incorporated into the soil.

VSDF = Vegetable surface deposition factor (m^2s/kg).

In calculating the average pollutant concentration from surface deposition, exposure duration was adjusted using a factor of 2/70. This factor is based on the assumption that pollutant deposition resulting from the 2 years of facility operation is averaged over a 70-year lifetime.

The VSDF is calculated according to the following equation (Holton et al., 1984):

$$VSDF = \frac{r\,(1 - e^{-kt})}{Yk}$$

Where:

- r = Interception fraction of the plant (unitless) (Baes et al., 1984).
- k = Total rate constant for degradation process (s^{-1}) (Baes et al., 1984).
- t = Growing time(s) (Ells, 1990).
- Y = Plant yield (wet weight) (kg/m^2) (Ennis, 1990).

The interception fraction refers to that fraction of the airborne material falling on a given growing area that is deposited upon (intercepted by) edible portions of the plant. The interception fractions used for lettuce (0.15) and tomatoes (0.068) are those computed by Baes et al. (1984) based on a theoretical model accounting for growth characteristics of the plants during their maturation in the field.

A number of degradation processes can affect the final concentrations of pollutants deposited on plant surfaces. These include weathering (mainly washoff by precipitation), volatilization, and photolysis. This analysis considered only weathering as a potential mechanism for loss of surface-deposited contamination. It was assumed that pollutants would remain sorbed to ash particles; therefore, only negligible amounts would undergo either volatilization or photolysis. Thus, the total rate constant for degradation processes (k) would be equal to the weathering loss removal constant (k_w). The weathering removal loss constant was calculated as follows (Baes et al., 1984):

$$k_w = \frac{\ln 2}{\text{half-life}} = 5.78 \times 10^{-7}\ s^{-1}$$

A half-life of 14 days (1.2×10^6 seconds), the value used by the U.S. Nuclear Regulatory Commission for particles (NCRP, 1984), was considered to be average for ash-bound pollutants. To be conservative, it was assumed in this assessment that no attenuation of surface contamination (e.g., by washing) takes place between the time the vegetables are harvested and eaten. The amount of a pollutant that can be removed by washing is highly variable, depending partially on the extent the pollutant is sorbed to, or can penetrate, the leaf (e.g., only about 10 percent of benzo(a) pyrene deposited on tomatoes and lettuce can be removed by cold water washing) (EPA, 1980).

Growing times for vegetables in the area surrounding RMA were estimated to be approximately 45 days (3.89E+06 seconds) for tomatoes from fruit set until harvest and 65 days (5.62E+06 seconds) for lettuce from initial leaf formation to harvest time (Ells, 1990). Average crop yields for the RMA area were estimated to be approximately 1.34 kg/m^2 and 1.58 kg/m^2 for tomatoes and lettuce, respectively (Ennis, 1990).

The concentrations of pollutants in lettuce resulting from surface deposition are summarized in Tables 8B-8 through 8B-13 for the three exposure scenarios. The concentrations of pollutants in tomatoes resulting from surface deposition are summarized in Tables 8B-14 through 8B-19 for the three exposure scenarios.

8B.2.2 Plant Uptake of Pollutants by Tomatoes and Lettuce

The accumulation of pollutants in edible parts of plants as a result of uptake from the soil is dependent on two processes: root absorption and translocation to the edible portion.

Table 8B-8

Average Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Resident-A Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	4.39E-14	5.69E-13	3.06E+00	1.74E-12	6.29E-15	1.75E-12	1.72E-16	8.11E-17
Aldrin	4.66E-16	6.03E-15	9.93E-05	5.99E-19	6.67E-17	6.73E-17	6.63E-21	3.12E-21
Atrazine	1.03E-16	1.39E-17	5.43E-02	7.55E-19	1.48E-17	1.56E-17	1.53E-21	7.22E-22
Benzaldehyde	9.54E-12	1.23E-10	2.69E-01	3.33E-11	1.37E-12	3.46E-11	3.42E-15	1.61E-15
Benzofuran	1.83E-11	2.37E-10	5.50E-02	1.30E-11	2.62E-12	1.57E-11	1.54E-15	7.26E-16
Benzoic Acid	4.62E-12	5.98E-11	1.60E-01	9.57E-12	6.61E-13	1.02E-11	1.01E-15	4.75E-16
Benzonitrile	4.39E-15	5.69E-14	2.42E-01	1.38E-14	6.29E-16	1.44E-14	1.42E-18	6.69E-19
Carbazole	8.79E-16	1.14E-14	2.40E-02	2.73E-16	1.26E-16	3.99E-16	3.94E-20	1.85E-20
4-Chlorobiphenyl	5.31E-12	6.88E-11	2.80E-03	1.92E-13	7.60E-13	9.53E-13	9.40E-17	4.42E-17
4,4-Chlorobiphenyl	6.96E-14	9.01E-13	1.13E-03	1.02E-15	9.96E-15	1.10E-14	1.08E-18	5.09E-19
4-Chlorophenylmethylsulfone	1.70E-15	4.58E-16	3.92E-01	1.79E-16	2.43E-16	4.22E-16	4.16E-20	1.96E-20
4-Chlorophenylmethylsulfoxide	6.32E-15	1.70E-15	3.29E-01	5.61E-16	9.05E-16	1.47E-15	1.45E-19	6.80E-20
p,p-DDE	7.74E-13	1.87E-12	9.74E-04	1.82E-15	1.11E-13	1.13E-13	1.11E-17	5.23E-18
p,p-DDT	1.55E-16	3.75E-16	3.98E-04	1.49E-19	2.22E-17	2.23E-17	2.20E-21	1.04E-21
Dibenzofuran	9.14E-13	1.18E-11	7.93E-03	9.39E-14	1.31E-13	2.25E-13	2.22E-17	1.04E-17
Dieldrin	9.56E-17	1.24E-15	4.93E-04	6.10E-19	1.37E-17	1.43E-17	1.41E-21	6.63E-22
Diisopropyl Methylphosphonate	1.68E-14	9.06E-15	1.93E-01	1.75E-15	2.40E-15	4.15E-15	4.09E-19	1.93E-19
1,3-Dimethylbenzene	1.83E-12	2.37E-11	2.71E-02	6.42E-13	2.62E-13	9.04E-13	8.92E-17	4.20E-17
Dimethyl Methylphosphonate	4.00E-13	3.57E-15	2.40E+01	8.55E-14	5.73E-14	1.43E-13	1.41E-17	6.63E-18
Dimethylphosphate	1.10E-13	1.42E-12			1.57E-14	1.57E-14	1.55E-18	7.29E-19
Dioxins/Furans (EPA TEFs)	2.80E-13	8.91E-13	5.64E-04	5.02E-16	4.02E-14	4.07E-14	4.01E-18	1.89E-18
Dithiane	1.68E-17	2.17E-16	6.96E-01	1.51E-16	2.40E-18	1.54E-16	1.51E-20	7.13E-21
Endrin	9.29E-17	2.49E-16	4.41E-03	1.10E-18	1.33E-17	1.44E-17	1.42E-21	6.68E-22
Hexachlorobenzene	3.12E-14	5.05E-14	1.31E-03	6.60E-17	4.47E-15	4.54E-15	4.47E-19	2.11E-19
Hexachlorocyclopentadiene	8.66E-16	1.12E-14	1.24E-03	1.39E-17	1.24E-16	1.38E-16	1.36E-20	6.40E-21
Isodrin	2.45E-16	3.17E-15	3.26E-04	1.03E-18	3.51E-17	3.61E-17	3.56E-21	1.68E-21
Malathion	3.74E-16	4.84E-15	4.10E-02	1.98E-16	5.36E-17	2.52E-16	2.49E-20	1.17E-20
Methanol	1.06E-11	1.38E-10	5.81E+00	8.00E-10	1.52E-12	8.01E-10	7.90E-14	3.72E-14
4-Nitrophenol	3.87E-15	5.01E-14	3.99E-02	2.00E-15	5.54E-16	2.55E-15	2.52E-19	1.19E-19
PAHs								
Acenaphthalene	4.58E-12	5.93E-11	8.48E-03	5.03E-13	6.56E-13	1.16E-12	1.14E-16	5.38E-17
Acenaphthene	4.58E-12	5.93E-11	1.04E-02	6.14E-13	6.56E-13	1.27E-12	1.25E-16	5.90E-17
Benzo(a)pyrene	9.14E-13	2.09E-13	3.68E-04	7.67E-17	1.31E-13	1.31E-13	1.29E-17	6.08E-18
Chrysene	9.14E-13	2.61E-13	8.53E-04	2.23E-16	1.31E-13	1.31E-13	1.29E-17	6.09E-18
Dibenzo(a,h)anthracene	9.14E-13	2.84E-13	3.30E-04	9.37E-17	1.31E-13	1.31E-13	1.29E-17	6.08E-18
Fluoranthene	2.75E-12	7.65E-13	1.83E-03	1.40E-15	3.94E-13	3.95E-13	3.89E-17	1.83E-17
Fluorene	9.14E-13	1.18E-11	5.60E-03	6.63E-14	1.31E-13	1.97E-13	1.95E-17	9.15E-18
Phenanthrene	1.83E-12	3.62E-13	4.35E-03	1.57E-15	2.62E-13	2.64E-13	2.60E-17	1.22E-17
Pyrene	9.14E-13	1.76E-13	1.93E-03	3.38E-16	1.31E-13	1.31E-13	1.29E-17	6.09E-18
Parathion	5.16E-17	6.68E-16	1.20E-02	8.02E-18	7.39E-18	1.54E-17	1.52E-21	7.15E-22
Pentachlorobenzene	1.40E-14	1.81E-13	2.20E-03	3.98E-16	2.00E-15	2.40E-15	2.36E-19	1.11E-19
Phenol	4.96E-11	6.42E-10	2.77E-01	1.78E-10	7.10E-12	1.85E-10	1.82E-14	8.57E-15
Quinoline	2.19E-15	2.83E-14	1.29E-01	3.66E-15	3.13E-16	3.98E-15	3.92E-19	1.84E-19

Table 8B-8
(continued)

Supona	1.55E-16	2.01E-15	3.06E-02	6.13E-17	2.22E-17	8.35E-17	8.24E-21	3.88E-21
Tetrachlorobenzene	5.89E-15	7.63E-14	5.68E-03	4.33E-16	8.43E-16	1.28E-15	1.26E-19	5.92E-20
Trichlorobenzene	3.10E-15	4.02E-14	9.56E-03	3.84E-16	4.45E-16	8.29E-16	8.17E-20	3.85E-20
Urea	6.71E-11	8.69E-10	1.03E+02	8.93E-08	9.61E-12	8.93E-08	8.80E-12	4.14E-12
Vapona	4.13E-16	5.35E-15	3.00E-01	1.60E-15	5.92E-17	1.66E-15	1.64E-19	7.72E-20
INORGANICS								
Antimony	4.26E-08	5.52E-07	1.00E-02	5.52E-09	6.11E-09	1.16E-08	1.15E-12	5.39E-13
Arsenic	2.41E-07	3.12E-06	2.00E-03	6.25E-09	3.45E-08	4.08E-08	4.02E-12	1.89E-12
Barium	5.91E-08	7.65E-07	7.50E-03	5.74E-09	8.46E-09	1.42E-08	1.40E-12	6.59E-13
Beryllium	2.47E-09	3.20E-08	5.00E-04	1.60E-11	3.53E-10	3.69E-10	3.64E-14	1.71E-14
Copper	2.26E-04	2.93E-03	2.00E-02	5.86E-05	3.24E-05	9.10E-05	8.97E-09	4.22E-09
Lead	7.57E-08	9.81E-07	2.25E-03	2.21E-09	1.08E-08	1.31E-08	1.29E-12	6.06E-13
Mercury	6.68E-08	8.64E-07	4.50E-02	3.89E-08	9.56E-09	4.85E-08	4.78E-12	2.25E-12
Selenium	6.19E-04	8.01E-03	1.25E-03	1.00E-05	8.86E-05	9.86E-05	9.73E-09	4.58E-09
Silver	6.41E-06	8.30E-05	2.00E-02	1.66E-06	9.18E-07	2.58E-06	2.54E-10	1.20E-10
Thallium	6.23E-07	8.06E-06	2.00E-04	1.61E-09	8.92E-08	9.08E-08	8.95E-12	4.21E-12

Table 8B-9

Average Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Resident-B Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	6.16E-15	8.23E-13	3.06E+00	2.52E-12	8.82E-16	2.52E-12	2.48E-16	1.17E-16
Aldrin	6.52E-17	8.72E-15	9.93E-05	8.65E-19	9.34E-18	1.02E-17	1.01E-21	4.74E-22
Atrazine	1.45E-17	2.01E-17	5.43E-02	1.09E-18	2.07E-18	3.17E-18	3.12E-22	1.47E-22
Benzaldehyde	1.34E-12	1.79E-10	2.69E-01	4.81E-11	1.91E-13	4.83E-11	4.76E-15	2.24E-15
Benzofuran	2.56E-12	3.43E-10	5.50E-02	1.88E-11	3.67E-13	1.92E-11	1.89E-15	8.91E-16
Benzoic Acid	6.47E-13	8.65E-11	1.60E-01	1.38E-11	9.27E-14	1.39E-11	1.37E-15	6.46E-16
Benzonitrile	6.16E-16	8.23E-14	2.42E-01	1.99E-14	8.82E-17	2.00E-14	1.97E-18	9.28E-19
Carbazole	1.23E-16	1.65E-14	2.40E-02	3.95E-16	1.76E-17	4.13E-16	4.07E-20	1.92E-20
4-Chlorobiphenyl	7.44E-13	9.94E-11	2.80E-03	2.78E-13	1.07E-13	3.85E-13	3.79E-17	1.79E-17
4,4-Chlorobiphenyl	9.75E-15	1.30E-12	1.13E-03	1.47E-15	1.40E-15	2.87E-15	2.82E-19	1.33E-19
4-Chlorophenylmethylsulfone	2.38E-16	6.62E-16	3.92E-01	2.59E-16	3.41E-17	2.93E-16	2.89E-20	1.36E-20
4-Chlorophenylmethylsulfoxide	8.86E-16	2.46E-15	3.29E-01	8.11E-16	1.27E-16	9.37E-16	9.24E-20	4.35E-20
p,p-DDE	1.08E-13	2.70E-12	9.74E-04	2.63E-15	1.55E-14	1.82E-14	1.79E-18	8.43E-19
p,p-DDT	2.17E-17	5.41E-16	3.98E-04	2.16E-19	3.11E-18	3.33E-18	3.28E-22	1.54E-22
Dibenzofuran	1.28E-13	1.71E-11	7.93E-03	1.36E-13	1.83E-14	1.54E-13	1.52E-17	7.15E-18
Dieldrin	1.34E-17	1.79E-15	4.93E-04	8.82E-19	1.92E-18	2.80E-18	2.76E-22	1.30E-22
Diisopropyl Methylphosphonate	2.35E-15	1.31E-14	1.93E-01	2.53E-15	3.37E-16	2.86E-15	2.82E-19	1.33E-19
1,3-Dimethylbenzene	2.56E-13	3.43E-11	2.71E-02	9.29E-13	3.67E-14	9.65E-13	9.52E-17	4.48E-17
Dimethyl Methylphosphonate	5.61E-14	5.16E-15	2.40E+01	1.24E-13	8.03E-15	1.32E-13	1.30E-17	6.11E-18
Dimethylphosphate	1.54E-14	2.05E-12			2.20E-15	2.20E-15	2.17E-19	1.02E-19
Dioxins/Furans (EPA TEFs)	3.93E-14	1.29E-12	5.64E-04	7.26E-16	5.63E-15	6.35E-15	6.26E-19	2.95E-19
Dithiane	2.35E-18	3.14E-16	6.96E-01	2.19E-16	3.37E-19	2.19E-16	2.16E-20	1.02E-20
Endrin	1.30E-17	3.59E-16	4.41E-03	1.58E-18	1.86E-18	3.45E-18	3.40E-22	1.60E-22
Hexachlorobenzene	4.38E-15	7.30E-14	1.31E-03	9.55E-17	6.27E-16	7.22E-16	7.12E-20	3.35E-20
Hexachlorocyclopentadiene	1.21E-16	1.62E-14	1.24E-03	2.01E-17	1.74E-17	3.75E-17	3.69E-21	1.74E-21
Isodrin	3.43E-17	4.59E-15	3.26E-04	1.49E-18	4.91E-18	6.41E-18	6.32E-22	2.97E-22
Malathion	5.24E-17	7.00E-15	4.10E-02	2.87E-16	7.50E-18	2.94E-16	2.90E-20	1.37E-20
Methanol	1.49E-12	1.99E-10	5.81E+00	1.16E-09	2.13E-13	1.16E-09	1.14E-13	5.36E-14
4-Nitrophenol	5.42E-16	7.25E-14	3.99E-02	2.89E-15	7.77E-17	2.97E-15	2.93E-19	1.38E-19
PAHs								
Acenaphthalene	6.42E-13	8.58E-11	8.48E-03	7.27E-13	9.19E-14	8.19E-13	8.08E-17	3.80E-17
Acenaphthene	6.42E-13	8.58E-11	1.04E-02	8.88E-13	9.19E-14	9.80E-13	9.67E-17	4.55E-17
Benzo(a)pyrene	1.28E-13	3.01E-13	3.68E-04	1.11E-16	1.83E-14	1.85E-14	1.82E-18	8.56E-19
Chrysene	1.28E-13	3.78E-13	8.53E-04	3.22E-16	1.83E-14	1.87E-14	1.84E-18	8.66E-19
Dibenzo(a,h)anthracene	1.28E-13	4.10E-13	3.30E-04	1.35E-16	1.83E-14	1.85E-14	1.82E-18	8.58E-19
Fluoranthene	3.85E-13	1.11E-12	1.83E-03	2.02E-15	5.51E-14	5.72E-14	5.64E-18	2.65E-18
Fluorene	1.28E-13	1.71E-11	5.60E-03	9.59E-14	1.83E-14	1.14E-13	1.13E-17	5.30E-18
Phenanthrene	2.56E-13	5.24E-13	4.35E-03	2.28E-15	3.67E-14	3.90E-14	3.85E-18	1.81E-18
Pyrene	1.28E-13	2.54E-13	1.93E-03	4.88E-16	1.83E-14	1.88E-14	1.86E-18	8.74E-19
Parathion	7.23E-18	9.66E-16	1.20E-02	1.16E-17	1.04E-18	1.26E-17	1.24E-21	5.86E-22
Pentachlorobenzene	1.96E-15	2.61E-13	2.20E-03	5.75E-16	2.80E-16	8.56E-16	8.44E-20	3.97E-20
Phenol	6.94E-12	9.28E-10	2.77E-01	2.57E-10	9.94E-13	2.58E-10	2.54E-14	1.20E-14
Quinoline	3.07E-16	4.10E-14	1.29E-01	5.29E-15	4.39E-17	5.34E-15	5.26E-19	2.48E-19

Table 8B-9
(continued)

Supona	2.17E-17	2.90E-15	3.06E-02	8.87E-17	3.11E-18	9.18E-17	9.05E-21	4.26E-21
Tetrachlorobenzene	8.25E-16	1.10E-13	5.68E-03	6.26E-16	1.18E-16	7.44E-16	7.34E-20	3.45E-20
Trichlorobenzene	4.35E-16	5.81E-14	9.56E-03	5.56E-16	6.23E-17	6.18E-16	6.09E-20	2.87E-20
Urea	9.41E-12	1.26E-09	1.03E+02	1.29E-07	1.35E-12	1.29E-07	1.27E-11	5.99E-12
Vapona	5.79E-17	7.74E-15	3.00E-01	2.32E-15	8.29E-18	2.33E-15	2.30E-19	1.08E-19
INORGANICS								
Antimony	5.97E-09	7.98E-07	1.00E-02	7.98E-09	8.55E-10	8.84E-09	8.71E-13	4.10E-13
Arsenic	3.38E-08	4.52E-06	2.00E-03	9.03E-09	4.84E-09	1.39E-08	1.37E-12	6.44E-13
Barium	8.28E-09	1.11E-06	7.50E-03	8.30E-09	1.19E-09	9.48E-09	9.35E-13	4.40E-13
Beryllium	3.46E-10	4.62E-08	5.00E-04	2.31E-11	4.95E-11	7.26E-11	7.16E-15	3.37E-15
Copper	3.17E-05	4.24E-03	2.00E-02	8.47E-05	4.54E-06	8.92E-05	8.80E-09	4.14E-09
Lead	1.06E-08	1.42E-06	2.25E-03	3.19E-09	1.52E-09	4.71E-09	4.64E-13	2.18E-13
Mercury	9.35E-09	1.25E-06	4.50E-02	5.62E-08	1.34E-09	5.76E-08	5.68E-12	2.67E-12
Selenium	8.67E-05	1.16E-02	1.25E-03	1.45E-05	1.24E-05	2.69E-05	2.65E-09	1.25E-09
Silver	8.99E-07	1.20E-04	2.00E-02	2.40E-06	1.29E-07	2.53E-06	2.49E-10	1.17E-10
Thallium	8.72E-08	1.17E-05	2.00E-04	2.33E-09	1.25E-08	1.48E-08	1.46E-12	6.88E-13

Table 8B-10

Average Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Farmer Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	1.52E-14	4.88E-13	3.06E+00	1.49E-12	2.17E-15	1.50E-12	2.29E-16	1.08E-16
Aldrin	1.61E-16	5.17E-15	9.93E-05	5.13E-19	2.30E-17	2.35E-17	3.60E-21	1.69E-21
Atrazine	3.57E-17	1.19E-17	5.43E-02	6.47E-19	5.11E-18	5.75E-18	8.80E-22	4.14E-22
Benzaldehyde	3.29E-12	1.06E-10	2.69E-01	2.85E-11	4.71E-13	2.90E-11	4.44E-15	2.09E-15
Benzofuran	6.31E-12	2.03E-10	5.50E-02	1.12E-11	9.04E-13	1.21E-11	1.85E-15	8.70E-16
Benzoic Acid	1.59E-12	5.13E-11	1.60E-01	8.20E-12	2.28E-13	8.43E-12	1.29E-15	6.07E-16
Benzonitrile	1.52E-15	4.88E-14	2.42E-01	1.18E-14	2.17E-16	1.20E-14	1.84E-18	8.66E-19
Carbazole	3.03E-16	9.75E-15	2.40E-02	2.34E-16	4.34E-17	2.78E-16	4.25E-20	2.00E-20
4-Chlorobiphenyl	1.83E-12	5.89E-11	2.80E-03	1.65E-13	2.62E-13	4.27E-13	6.54E-17	3.08E-17
4,4-Chlorobiphenyl	2.40E-14	7.72E-13	1.13E-03	8.71E-16	3.44E-15	4.31E-15	6.59E-19	3.10E-19
4-Chlorophenylmethylsulfone	5.86E-16	3.92E-16	3.92E-01	1.54E-16	8.39E-17	2.37E-16	3.63E-20	1.71E-20
4-Chlorophenylmethylsulfoxide	2.18E-15	1.46E-15	3.29E-01	4.81E-16	3.12E-16	7.93E-16	1.21E-19	5.71E-20
p,p-DDE	2.67E-13	1.60E-12	9.74E-04	1.56E-15	3.82E-14	3.98E-14	6.09E-18	2.87E-18
p,p-DDT	5.35E-17	3.21E-16	3.98E-04	1.28E-19	7.66E-18	7.78E-18	1.19E-21	5.60E-22
Dibenzofuran	3.15E-13	1.01E-11	7.93E-03	8.05E-14	4.52E-14	1.26E-13	1.92E-17	9.05E-18
Dieldrin	3.30E-17	1.06E-15	4.93E-04	5.23E-19	4.72E-18	5.24E-18	8.02E-22	3.77E-22
Diisopropyl Methylphosphonate	5.79E-15	7.76E-15	1.93E-01	1.50E-15	8.29E-16	2.33E-15	3.56E-19	1.68E-19
1,3-Dimethylbenzene	6.31E-13	2.03E-11	2.71E-02	5.51E-13	9.04E-14	6.41E-13	9.81E-17	4.61E-17
Dimethyl Methylphosphonate	1.38E-13	3.06E-15	2.40E+01	7.33E-14	1.98E-14	9.30E-14	1.42E-17	6.70E-18
Dimethylphosphate	3.79E-14	1.22E-12			5.42E-15	5.42E-15	8.29E-19	3.90E-19
Dioxins/Furans (EPA TEFs)	9.68E-14	7.64E-13	5.64E-04	4.30E-16	1.39E-14	1.43E-14	2.19E-18	1.03E-18
Dithiane	5.79E-18	1.86E-16	6.96E-01	1.30E-16	8.29E-19	1.30E-16	2.00E-20	9.39E-21
Endrin	3.21E-17	2.13E-16	4.41E-03	9.39E-19	4.59E-18	5.53E-18	8.46E-22	3.98E-22
Hexachlorobenzene	1.08E-14	4.33E-14	1.31E-03	5.66E-17	1.54E-15	1.60E-15	2.45E-19	1.15E-19
Hexachlorocyclopentadiene	2.99E-16	9.61E-15	1.24E-03	1.19E-17	4.28E-17	5.47E-17	8.36E-21	3.94E-21
Isodrin	8.45E-17	2.72E-15	3.26E-04	8.86E-19	1.21E-17	1.30E-17	1.99E-21	9.35E-22
Malathion	1.29E-16	4.15E-15	4.10E-02	1.70E-16	1.85E-17	1.89E-16	2.89E-20	1.36E-20
Methanol	3.66E-12	1.18E-10	5.81E+00	6.85E-10	5.25E-13	6.86E-10	1.05E-13	4.94E-14
4-Nitrophenol	1.34E-15	4.30E-14	3.99E-02	1.71E-15	1.91E-16	1.91E-15	2.92E-19	1.37E-19
PAHs								
Acenaphthalene	1.58E-12	5.08E-11	8.48E-03	4.31E-13	2.26E-13	6.57E-13	1.01E-16	4.73E-17
Acenaphthene	1.58E-12	5.08E-11	1.04E-02	5.27E-13	2.26E-13	7.53E-13	1.15E-16	5.42E-17
Benzo(a)pyrene	3.15E-13	1.79E-13	3.68E-04	6.57E-17	4.52E-14	4.52E-14	6.92E-18	3.26E-18
Chrysene	3.15E-13	2.24E-13	8.53E-04	1.91E-16	4.52E-14	4.54E-14	6.94E-18	3.27E-18
Dibenzo(a,h)anthracene	3.15E-13	2.43E-13	3.30E-04	8.03E-17	4.52E-14	4.52E-14	6.92E-18	3.26E-18
Fluoranthene	9.48E-13	6.56E-13	1.83E-03	1.20E-15	1.36E-13	1.37E-13	2.10E-17	9.86E-18
Fluorene	3.15E-13	1.01E-11	5.60E-03	5.69E-14	4.52E-14	1.02E-13	1.56E-17	7.35E-18
Phenanthrene	6.31E-13	3.10E-13	4.35E-03	1.35E-15	9.04E-14	9.18E-14	1.40E-17	6.61E-18
Pyrene	3.15E-13	1.50E-13	1.93E-03	2.90E-16	4.52E-14	4.55E-14	6.95E-18	3.27E-18
Parathion	1.78E-17	5.73E-16	1.20E-02	6.87E-18	2.55E-18	9.42E-18	1.44E-21	6.78E-22
Pentachlorobenzene	4.82E-15	1.55E-13	2.20E-03	3.41E-16	6.90E-16	1.03E-15	1.58E-19	7.42E-20
Phenol	1.71E-11	5.50E-10	2.77E-01	1.52E-10	2.45E-12	1.55E-10	2.37E-14	1.11E-14
Quinoline	7.55E-16	2.43E-14	1.29E-01	3.14E-15	1.08E-16	3.25E-15	4.97E-19	2.34E-19

Table 8B-10
(continued)

Supona	5.35E-17	1.72E-15	3.06E-02	5.26E-17	7.66E-18	6.02E-17	9.21E-21	4.34E-21
Tetrachlorobenzene	2.03E-15	6.54E-14	5.68E-03	3.71E-16	2.91E-16	6.62E-16	1.01E-19	4.77E-20
Trichlorobenzene	1.07E-15	3.44E-14	9.56E-03	3.29E-16	1.53E-16	4.83E-16	7.39E-20	3.48E-20
Urea	2.32E-11	7.45E-10	1.03E+02	7.65E-08	3.32E-12	7.65E-08	1.17E-11	5.51E-12
Vapona	1.43E-16	4.59E-15	3.00E-01	1.38E-15	2.04E-17	1.40E-15	2.14E-19	1.00E-19
INORGANICS								
Antimony	1.47E-08	4.73E-07	1.00E-02	4.73E-09	2.11E-09	6.84E-09	1.05E-12	4.92E-13
Arsenic	8.32E-08	2.68E-06	2.00E-03	5.35E-09	1.19E-08	1.73E-08	2.64E-12	1.24E-12
Barium	2.04E-08	6.56E-07	7.50E-03	4.92E-09	2.92E-09	7.84E-09	1.20E-12	5.64E-13
Beryllium	8.51E-10	2.74E-08	5.00E-04	1.37E-11	1.22E-10	1.36E-10	2.07E-14	9.76E-15
Copper	7.80E-05	2.51E-03	2.00E-02	5.02E-05	1.12E-05	6.14E-05	9.39E-09	4.42E-09
Lead	2.61E-08	8.40E-07	2.25E-03	1.89E-09	3.74E-09	5.63E-09	8.62E-13	4.05E-13
Mercury	2.30E-08	7.41E-07	4.50E-02	3.33E-08	3.30E-09	3.66E-08	5.61E-12	2.64E-12
Selenium	2.13E-04	6.87E-03	1.25E-03	8.59E-06	3.06E-05	3.92E-05	5.99E-09	2.82E-09
Silver	2.21E-06	7.12E-05	2.00E-02	1.42E-06	3.17E-07	1.74E-06	2.66E-10	1.25E-10
Thallium	2.15E-07	6.91E-06	2.00E-04	1.38E-09	3.08E-08	3.21E-08	4.92E-12	2.31E-12

Table 8B-11

Maximum Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Resident-A Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	4.39E-14	5.77E-13	3.06E+00	1.77E-12	2.20E-13	1.99E-12	1.96E-16	9.22E-17
Aldrin	4.66E-16	6.12E-15	9.93E-05	6.07E-19	2.33E-15	2.33E-15	2.30E-19	1.08E-19
Atrazine	1.03E-16	4.57E-16	5.43E-02	2.48E-17	5.18E-16	5.43E-16	5.35E-20	2.52E-20
Benzaldehyde	9.54E-12	1.25E-10	2.69E-01	3.38E-11	4.78E-11	8.16E-11	8.04E-15	3.78E-15
Benzofuran	1.83E-11	2.40E-10	5.50E-02	1.32E-11	9.18E-11	1.05E-10	1.04E-14	4.87E-15
Benzoic Acid	4.62E-12	6.07E-11	1.60E-01	9.71E-12	2.31E-11	3.29E-11	3.24E-15	1.52E-15
Benzonitrile	4.39E-15	5.77E-14	2.42E-01	1.40E-14	2.20E-14	3.60E-14	3.55E-18	1.67E-18
Carbazole	8.79E-16	1.15E-14	2.40E-02	2.77E-16	4.40E-15	4.68E-15	4.62E-19	2.17E-19
4-Chlorobiphenyl	5.31E-12	6.98E-11	2.80E-03	1.95E-13	2.66E-11	2.68E-11	2.64E-15	1.24E-15
4,4-Chlorobiphenyl	6.96E-14	9.14E-13	1.13E-03	1.03E-15	3.49E-13	3.50E-13	3.45E-17	1.62E-17
4-Chlorophenylmethylsulfone	1.70E-15	1.20E-14	3.92E-01	4.70E-15	8.51E-15	1.32E-14	1.30E-18	6.13E-19
4-Chlorophenylmethylsulfoxide	6.32E-15	4.47E-14	3.29E-01	1.47E-14	3.17E-14	4.64E-14	4.57E-18	2.15E-18
p,p-DDE	7.74E-13	9.39E-12	9.74E-04	9.15E-15	3.88E-12	3.89E-12	3.83E-16	1.80E-16
p,p-DDT	1.55E-16	1.88E-15	3.98E-04	7.49E-19	7.77E-16	7.78E-16	7.67E-20	3.61E-20
Dibenzofuran	9.14E-13	1.20E-11	7.93E-03	9.53E-14	4.58E-12	4.68E-12	4.61E-16	2.17E-16
Dieldrin	9.56E-17	1.26E-15	4.93E-04	6.19E-19	4.79E-16	4.80E-16	4.73E-20	2.23E-20
Diisopropyl Methylphosphonate	1.68E-14	1.59E-13	1.93E-01	3.06E-14	8.42E-14	1.15E-13	1.13E-17	5.32E-18
1,3-Dimethylbenzene	1.83E-12	2.40E-11	2.71E-02	6.52E-13	9.18E-12	9.83E-12	9.69E-16	4.56E-16
Dimethyl Methylphosphonate	4.00E-13	1.25E-13	2.40E+01	2.99E-12	2.01E-12	5.00E-12	4.93E-16	2.32E-16
Dimethylphosphate	1.10E-13	1.44E-12			5.50E-13	5.50E-13	5.42E-17	2.55E-17
Dioxins/Furans (EPA TEFs)	2.80E-13	3.47E-12	5.64E-04	1.95E-15	1.41E-12	1.41E-12	1.39E-16	6.53E-17
Dithiane	1.68E-17	2.21E-16	6.96E-01	1.53E-16	8.42E-17	2.38E-16	2.34E-20	1.10E-20
Endrin	9.29E-17	1.14E-15	4.41E-03	5.01E-18	4.66E-16	4.71E-16	4.64E-20	2.18E-20
Hexachlorobenzene	3.12E-14	3.65E-13	1.31E-03	4.77E-16	1.57E-13	1.57E-13	1.55E-17	7.28E-18
Hexachlorocyclopentadiene	8.66E-16	1.14E-14	1.24E-03	1.41E-17	4.34E-15	4.35E-15	4.29E-19	2.02E-19
Isodrin	2.45E-16	3.22E-15	3.26E-04	1.05E-18	1.23E-15	1.23E-15	1.21E-19	5.70E-20
Malathion	3.74E-16	4.91E-15	4.10E-02	2.01E-16	1.87E-15	2.08E-15	2.05E-19	9.63E-20
Methanol	1.06E-11	1.40E-10	5.81E+00	8.11E-10	5.32E-11	8.64E-10	8.52E-14	4.01E-14
4-Nitrophenol	3.87E-15	5.08E-14	3.99E-02	2.03E-15	1.94E-14	2.14E-14	2.11E-18	9.94E-19
PAHs								
Acenaphthalene	4.58E-12	6.02E-11	8.48E-03	5.10E-13	2.30E-11	2.35E-11	2.31E-15	1.09E-15
Acenaphthene	4.58E-12	6.02E-11	1.04E-02	6.23E-13	2.30E-11	2.36E-11	2.33E-15	1.09E-15
Benzo(a)pyrene	9.14E-13	5.88E-12	3.68E-04	2.16E-15	4.58E-12	4.59E-12	4.52E-16	2.13E-16
Chrysene	9.14E-13	6.67E-12	8.53E-04	5.69E-15	4.58E-12	4.59E-12	4.52E-16	2.13E-16
Dibenzo(a,h)anthracene	9.14E-13	6.95E-12	3.30E-04	2.30E-15	4.58E-12	4.59E-12	4.52E-16	2.13E-16
Fluoranthene	2.75E-12	1.98E-11	1.83E-03	3.61E-14	1.38E-11	1.38E-11	1.36E-15	6.41E-16
Fluorene	9.14E-13	1.20E-11	5.60E-03	6.73E-14	4.58E-12	4.65E-12	4.59E-16	2.16E-16
Phenanthrene	1.83E-12	1.08E-11	4.35E-03	4.67E-14	9.18E-12	9.22E-12	9.09E-16	4.28E-16
Pyrene	9.14E-13	5.27E-12	1.93E-03	1.01E-14	4.58E-12	4.59E-12	4.53E-16	2.13E-16
Parathion	5.16E-17	6.78E-16	1.20E-02	8.13E-18	2.59E-16	2.67E-16	2.63E-20	1.24E-20
Pentachlorobenzene	1.40E-14	1.83E-13	2.20E-03	4.04E-16	7.00E-14	7.04E-14	6.94E-18	3.27E-18
Phenol	4.96E-11	6.51E-10	2.77E-01	1.80E-10	2.48E-10	4.29E-10	4.23E-14	1.99E-14
Quinoline	2.19E-15	2.87E-14	1.29E-01	3.71E-15	1.10E-14	1.47E-14	1.45E-18	6.81E-19

Table 8B-11
(continued)

Supona	1.55E-16	2.04E-15	3.06E-02	6.22E-17	7.77E-16	8.39E-16	8.27E-20	3.89E-20
Tetrachlorobenzene	5.89E-15	7.74E-14	5.68E-03	4.39E-16	2.95E-14	3.00E-14	2.95E-18	1.39E-18
Trichlorobenzene	3.10E-15	4.08E-14	9.56E-03	3.90E-16	1.56E-14	1.59E-14	1.57E-18	7.40E-19
Urea	6.71E-11	8.82E-10	1.03E+02	9.05E-08	3.36E-10	9.09E-08	8.96E-12	4.22E-12
Vapona	4.13E-16	5.43E-15	3.00E-01	1.63E-15	2.07E-15	3.70E-15	3.65E-19	1.72E-19
INORGANICS								
Antimony	4.26E-08	5.60E-07	1.00E-02	5.60E-09	2.14E-07	2.19E-07	2.16E-11	1.02E-11
Arsenic	2.41E-07	3.17E-06	2.00E-03	6.34E-09	1.21E-06	1.22E-06	1.20E-10	5.64E-11
Barium	5.91E-08	7.76E-07	7.50E-03	5.82E-09	2.96E-07	3.02E-07	2.98E-11	1.40E-11
Beryllium	2.47E-09	3.24E-08	5.00E-04	1.62E-11	1.24E-08	1.24E-08	1.22E-12	5.75E-13
Copper	2.26E-04	2.97E-03	2.00E-02	5.94E-05	1.13E-03	1.19E-03	1.18E-07	5.54E-08
Lead	7.57E-08	9.95E-07	2.25E-03	2.24E-09	3.80E-07	3.82E-07	3.76E-11	1.77E-11
Mercury	6.68E-08	8.77E-07	4.50E-02	3.95E-08	3.35E-07	3.74E-07	3.69E-11	1.74E-11
Selenium	6.19E-04	8.13E-03	1.25E-03	1.02E-05	3.10E-03	3.11E-03	3.07E-07	1.44E-07
Silver	6.41E-06	8.42E-05	2.00E-02	1.68E-06	3.21E-05	3.38E-05	3.34E-09	1.57E-09
Thallium	6.23E-07	8.18E-06	2.00E-04	1.64E-09	3.12E-06	3.12E-06	3.08E-10	1.45E-10

Table 8B-12

Maximum Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Resident-B Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	6.16E-15	8.34E-13	3.06E+00	2.56E-12	3.09E-14	2.59E-12	2.55E-16	1.20E-16
Aldrin	6.52E-17	8.84E-15	9.93E-05	8.78E-19	3.27E-16	3.28E-16	3.23E-20	1.52E-20
Atrazine	1.45E-17	6.60E-16	5.43E-02	3.58E-17	7.26E-17	1.08E-16	1.07E-20	5.03E-21
Benzaldehyde	1.34E-12	1.81E-10	2.69E-01	4.88E-11	6.70E-12	5.55E-11	5.47E-15	2.58E-15
Benzofuran	2.56E-12	3.48E-10	5.50E-02	1.91E-11	1.29E-11	3.20E-11	3.15E-15	1.48E-15
Benzoic Acid	6.47E-13	8.77E-11	1.60E-01	1.40E-11	3.24E-12	1.73E-11	1.70E-15	8.02E-16
Benzonitrile	6.16E-16	8.34E-14	2.42E-01	2.02E-14	3.09E-15	2.33E-14	2.30E-18	1.08E-18
Carbazole	1.23E-16	1.67E-14	2.40E-02	4.01E-16	6.17E-16	1.02E-15	1.00E-19	4.72E-20
4-Chlorobiphenyl	7.44E-13	1.01E-10	2.80E-03	2.82E-13	3.73E-12	4.01E-12	3.96E-16	1.86E-16
4,4-Chlorobiphenyl	9.75E-15	1.32E-12	1.13E-03	1.49E-15	4.88E-14	5.03E-14	4.96E-18	2.34E-18
4-Chlorophenylmethylsulfone	2.38E-16	1.74E-14	3.92E-01	6.80E-15	1.19E-15	8.00E-15	7.88E-19	3.71E-19
4-Chlorophenylmethylsulfoxide	8.86E-16	6.46E-14	3.29E-01	2.13E-14	4.44E-15	2.57E-14	2.54E-18	1.19E-18
p,p-DDE	1.08E-13	1.36E-11	9.74E-04	1.32E-14	5.44E-13	5.57E-13	5.49E-17	2.58E-17
p,p-DDT	2.17E-17	2.72E-15	3.98E-04	1.08E-18	1.09E-16	1.10E-16	1.08E-20	5.10E-21
Dibenzofuran	1.28E-13	1.74E-11	7.93E-03	1.38E-13	6.42E-13	7.80E-13	7.69E-17	3.62E-17
Dieldrin	1.34E-17	1.81E-15	4.93E-04	8.95E-19	6.71E-17	6.80E-17	6.70E-21	3.15E-21
Diisopropyl Methylphosphonate	2.35E-15	2.29E-13	1.93E-01	4.42E-14	1.18E-14	5.60E-14	5.52E-18	2.60E-18
1,3-Dimethylbenzene	2.56E-13	3.48E-11	2.71E-02	9.42E-13	1.29E-12	2.23E-12	2.20E-16	1.03E-16
Dimethyl Methylphosphonate	5.61E-14	1.81E-13	2.40E+01	4.33E-12	2.81E-13	4.61E-12	4.54E-16	2.14E-16
Dimethylphosphate	1.54E-14	2.08E-12			7.71E-14	7.71E-14	7.60E-18	3.58E-18
Dioxins/Furans (EPA TEFs)	3.93E-14	5.01E-12	5.64E-04	2.82E-15	1.97E-13	2.00E-13	1.97E-17	9.27E-18
Dithiane	2.35E-18	3.19E-16	6.96E-01	2.22E-16	1.18E-17	2.34E-16	2.30E-20	1.08E-20
Endrin	1.30E-17	1.64E-15	4.41E-03	7.24E-18	6.53E-17	7.25E-17	7.15E-21	3.36E-21
Hexachlorobenzene	4.38E-15	5.28E-13	1.31E-03	6.90E-16	2.19E-14	2.26E-14	2.23E-18	1.05E-18
Hexachlorocyclopentadiene	1.21E-16	1.64E-14	1.24E-03	2.04E-17	6.08E-16	6.28E-16	6.20E-20	2.92E-20
Isodrin	3.43E-17	4.65E-15	3.26E-04	1.52E-18	1.72E-16	1.74E-16	1.71E-20	8.05E-21
Malathion	5.24E-17	7.10E-15	4.10E-02	2.91E-16	2.63E-16	5.54E-16	5.46E-20	2.57E-20
Methanol	1.49E-12	2.02E-10	5.81E+00	1.17E-09	7.46E-12	1.18E-09	1.16E-13	5.48E-14
4-Nitrophenol	5.42E-16	7.35E-14	3.99E-02	2.93E-15	2.72E-15	5.65E-15	5.57E-19	2.62E-19
PAHs								
Acenaphthalene	6.42E-13	8.70E-11	8.48E-03	7.38E-13	3.22E-12	3.95E-12	3.90E-16	1.83E-16
Acenaphthene	6.42E-13	8.70E-11	1.04E-02	9.01E-13	3.22E-12	4.12E-12	4.06E-16	1.91E-16
Benzo(a)pyrene	1.28E-13	8.50E-12	3.68E-04	3.12E-15	6.42E-13	6.45E-13	6.36E-17	2.99E-17
Chrysene	1.28E-13	9.64E-12	8.53E-04	8.22E-15	6.42E-13	6.50E-13	6.41E-17	3.02E-17
Dibenzo(a,h)anthracene	1.28E-13	1.01E-11	3.30E-04	3.32E-15	6.42E-13	6.45E-13	6.36E-17	2.99E-17
Fluoranthene	3.85E-13	2.86E-11	1.83E-03	5.22E-14	1.93E-12	1.98E-12	1.95E-16	9.20E-17
Fluorene	1.28E-13	1.74E-11	5.60E-03	9.73E-14	6.42E-13	7.39E-13	7.29E-17	3.43E-17
Phenanthrene	2.56E-13	1.56E-11	4.35E-03	6.76E-14	1.29E-12	1.35E-12	1.33E-16	6.28E-17
Pyrene	1.28E-13	7.61E-12	1.93E-03	1.47E-14	6.42E-13	6.57E-13	6.48E-17	3.05E-17
Parathion	7.23E-18	9.80E-16	1.20E-02	1.18E-17	3.62E-17	4.80E-17	4.73E-21	2.23E-21
Pentachlorobenzene	1.96E-15	2.65E-13	2.20E-03	5.84E-16	9.81E-15	1.04E-14	1.02E-18	4.82E-19
Phenol	6.94E-12	9.41E-10	2.77E-01	2.60E-10	3.48E-11	2.95E-10	2.91E-14	1.37E-14
Quinoline	3.07E-16	4.15E-14	1.29E-01	5.37E-15	1.54E-15	6.91E-15	6.81E-19	3.20E-19

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Table 8B-12
(continued)

Supona	2.17E-17	2.94E-15	3.06E-02	9.00E-17	1.09E-16	1.99E-16	1.96E-20	9.22E-21
Tetrachlorobenzene	8.25E-16	1.12E-13	5.68E-03	6.35E-16	4.14E-15	4.77E-15	4.70E-19	2.21E-19
Trichlorobenzene	4.35E-16	5.89E-14	9.56E-03	5.64E-16	2.18E-15	2.74E-15	2.70E-19	1.27E-19
Urea	9.41E-12	1.27E-09	1.03E+02	1.31E-07	4.71E-11	1.31E-07	1.29E-11	6.08E-12
Vapona	5.79E-17	7.85E-15	3.00E-01	2.35E-15	2.90E-16	2.64E-15	2.61E-19	1.23E-19
INORGANICS								
Antimony	5.97E-09	8.10E-07	1.00E-02	8.10E-09	2.99E-08	3.80E-08	3.75E-12	1.76E-12
Arsenic	3.38E-08	4.58E-06	2.00E-03	9.16E-09	1.69E-07	1.79E-07	1.76E-11	8.28E-12
Barium	8.28E-09	1.12E-06	7.50E-03	8.42E-09	4.15E-08	4.99E-08	4.92E-12	2.32E-12
Beryllium	3.46E-10	4.69E-08	5.00E-04	2.34E-11	1.73E-09	1.76E-09	1.73E-13	8.15E-14
Copper	3.17E-05	4.30E-03	2.00E-02	8.59E-05	1.59E-04	2.45E-04	2.41E-08	1.14E-08
Lead	1.06E-08	1.44E-06	2.25E-03	3.24E-09	5.32E-08	5.64E-08	5.56E-12	2.62E-12
Mercury	9.35E-09	1.27E-06	4.50E-02	5.70E-08	4.69E-08	1.04E-07	1.02E-11	4.82E-12
Selenium	8.67E-05	1.18E-02	1.25E-03	1.47E-05	4.35E-04	4.49E-04	4.43E-08	2.08E-08
Silver	8.99E-07	1.22E-04	2.00E-02	2.44E-06	4.50E-06	6.94E-06	6.84E-10	3.22E-10
Thallium	8.72E-08	1.18E-05	2.00E-04	2.36E-09	4.37E-07	4.40E-07	4.33E-11	2.04E-11

Table 8B-13

Maximum Pollutant Concentration in Lettuce, and Adult and Child Daily Intake at the Farmer Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	1.52E-14	4.95E-13	3.06E+00	1.52E-12	7.60E-14	1.59E-12	2.43E-16	1.15E-16
Aldrin	1.61E-16	5.24E-15	9.93E-05	5.21E-19	8.05E-16	8.05E-16	1.23E-19	5.80E-20
Atrazine	3.57E-17	3.92E-16	5.43E-02	2.12E-17	1.79E-16	2.00E-16	3.06E-20	1.44E-20
Benzaldehyde	3.29E-12	1.07E-10	2.69E-01	2.89E-11	1.65E-11	4.54E-11	6.95E-15	3.27E-15
Benzofuran	6.31E-12	2.06E-10	5.50E-02	1.13E-11	3.16E-11	4.30E-11	6.58E-15	3.09E-15
Benzoic Acid	1.59E-12	5.20E-11	1.60E-01	8.32E-12	7.98E-12	1.63E-11	2.50E-15	1.17E-15
Benzonitrile	1.52E-15	4.95E-14	2.42E-01	1.20E-14	7.60E-15	1.96E-14	3.00E-18	1.41E-18
Carbazole	3.03E-16	9.89E-15	2.40E-02	2.38E-16	1.52E-15	1.76E-15	2.69E-19	1.27E-19
4-Chlorobiphenyl	1.83E-12	5.98E-11	2.80E-03	1.67E-13	9.18E-12	9.35E-12	1.43E-15	6.73E-16
4,4-Chlorobiphenyl	2.40E-14	7.83E-13	1.13E-03	8.84E-16	1.20E-13	1.21E-13	1.85E-17	8.72E-18
4-Chlorophenylmethylsulfone	5.86E-16	1.03E-14	3.92E-01	4.03E-15	2.94E-15	6.97E-15	1.07E-18	5.02E-19
4-Chlorophenylmethylsulfoxide	2.18E-15	3.83E-14	3.29E-01	1.26E-14	1.09E-14	2.35E-14	3.60E-18	1.70E-18
p,p-DDE	2.67E-13	8.05E-12	9.74E-04	7.84E-15	1.34E-12	1.35E-12	2.06E-16	9.69E-17
p,p-DDT	5.35E-17	1.61E-15	3.98E-04	6.42E-19	2.68E-16	2.69E-16	4.11E-20	1.93E-20
Dibenzofuran	3.15E-13	1.03E-11	7.93E-03	8.16E-14	1.58E-12	1.66E-12	2.54E-16	1.20E-16
Dieldrin	3.30E-17	1.08E-15	4.93E-04	5.30E-19	1.65E-16	1.66E-16	2.54E-20	1.19E-20
Diisopropyl Methylphosphonate	5.79E-15	1.36E-13	1.93E-01	2.62E-14	2.90E-14	5.52E-14	8.45E-18	3.98E-18
1,3-Dimethylbenzene	6.31E-13	2.06E-11	2.71E-02	5.58E-13	3.16E-12	3.72E-12	5.70E-16	2.68E-16
Dimethyl Methylphosphonate	1.38E-13	1.07E-13	2.40E+01	2.57E-12	6.92E-13	3.26E-12	4.98E-16	2.34E-16
Dimethylphosphate	3.79E-14	1.24E-12			1.90E-13	1.90E-13	2.90E-17	1.37E-17
Dioxins/Furans (EPA TEFs)	9.68E-14	2.97E-12	5.64E-04	1.67E-15	4.85E-13	4.87E-13	7.44E-17	3.50E-17
Dithiane	5.79E-18	1.89E-16	6.96E-01	1.31E-16	2.90E-17	1.61E-16	2.46E-20	1.16E-20
Endrin	3.21E-17	9.73E-16	4.41E-03	4.29E-18	1.61E-16	1.65E-16	2.52E-20	1.19E-20
Hexachlorobenzene	1.08E-14	3.13E-13	1.31E-03	4.09E-16	5.40E-14	5.44E-14	8.32E-18	3.92E-18
Hexachlorocyclopentadiene	2.99E-16	9.75E-15	1.24E-03	1.21E-17	1.50E-15	1.51E-15	2.31E-19	1.09E-19
Isodrin	8.45E-17	2.76E-15	3.26E-04	8.99E-19	4.23E-16	4.24E-16	6.49E-20	3.06E-20
Malathion	1.29E-16	4.21E-15	4.10E-02	1.73E-16	6.47E-16	8.19E-16	1.25E-19	5.90E-20
Methanol	3.66E-12	1.20E-10	5.81E+00	6.95E-10	1.84E-11	7.14E-10	1.09E-13	5.14E-14
4-Nitrophenol	1.34E-15	4.36E-14	3.99E-02	1.74E-15	6.69E-15	8.43E-15	1.29E-18	6.07E-19
PAHs								
Acenaphthalene	1.58E-12	5.16E-11	8.48E-03	4.37E-13	7.92E-12	8.36E-12	1.28E-15	6.02E-16
Acenaphthene	1.58E-12	5.16E-11	1.04E-02	5.34E-13	7.92E-12	8.45E-12	1.29E-15	6.09E-16
Benzo(a)pyrene	3.15E-13	5.04E-12	3.68E-04	1.85E-15	1.58E-12	1.58E-12	2.42E-16	1.14E-16
Chrysene	3.15E-13	5.72E-12	8.53E-04	4.88E-15	1.58E-12	1.59E-12	2.43E-16	1.14E-16
Dibenzo(a,h)anthracene	3.15E-13	5.96E-12	3.30E-04	1.97E-15	1.58E-12	1.58E-12	2.42E-16	1.14E-16
Fluoranthene	9.48E-13	1.70E-11	1.83E-03	3.10E-14	4.75E-12	4.78E-12	7.32E-16	3.44E-16
Fluorene	3.15E-13	1.03E-11	5.60E-03	5.77E-14	1.58E-12	1.64E-12	2.51E-16	1.18E-16
Phenanthrene	6.31E-13	9.22E-12	4.35E-03	4.01E-14	3.16E-12	3.20E-12	4.90E-16	2.31E-16
Pyrene	3.15E-13	4.51E-12	1.93E-03	8.69E-15	1.58E-12	1.59E-12	2.43E-16	1.14E-16
Parathion	1.78E-17	5.81E-16	1.20E-02	6.97E-18	8.92E-17	9.62E-17	1.47E-20	6.93E-21
Pentachlorobenzene	4.82E-15	1.57E-13	2.20E-03	3.46E-16	2.41E-14	2.45E-14	3.75E-18	1.76E-18
Phenol	1.71E-11	5.58E-10	2.77E-01	1.54E-10	8.57E-11	2.40E-10	3.67E-14	1.73E-14
Quinoline	7.55E-16	2.46E-14	1.29E-01	3.18E-15	3.78E-15	6.97E-15	1.07E-18	5.02E-19

Table 8B-13
(continued)

Supona	5.35E-17	1.75E-15	3.06E-02	5.33E-17	2.68E-16	3.21E-16	4.92E-20	2.31E-20
Tetrachlorobenzene	2.03E-15	6.63E-14	5.68E-03	3.77E-16	1.02E-14	1.06E-14	1.62E-18	7.60E-19
Trichlorobenzene	1.07E-15	3.49E-14	9.56E-03	3.34E-16	5.37E-15	5.70E-15	8.72E-19	4.10E-19
Urea	2.32E-11	7.56E-10	1.03E+02	7.76E-08	1.16E-10	7.77E-08	1.19E-11	5.60E-12
Vapona	1.43E-16	4.65E-15	3.00E-01	1.40E-15	7.14E-16	2.11E-15	3.23E-19	1.52E-19
INORGANICS								
Antimony	1.47E-08	4.80E-07	1.00E-02	4.80E-09	7.37E-08	7.85E-08	1.20E-11	5.65E-12
Arsenic	8.32E-08	2.72E-06	2.00E-03	5.43E-09	4.17E-07	4.22E-07	6.46E-11	3.04E-11
Barium	2.04E-08	6.65E-07	7.50E-03	4.99E-09	1.02E-07	1.07E-07	1.64E-11	7.71E-12
Beryllium	8.51E-10	2.78E-08	5.00E-04	1.39E-11	4.27E-09	4.28E-09	6.55E-13	3.08E-13
Copper	7.80E-05	2.55E-03	2.00E-02	5.09E-05	3.91E-04	4.42E-04	6.76E-08	3.18E-08
Lead	2.61E-08	8.53E-07	2.25E-03	1.92E-09	1.31E-07	1.33E-07	2.03E-11	9.56E-12
Mercury	2.30E-08	7.52E-07	4.50E-02	3.38E-08	1.15E-07	1.49E-07	2.28E-11	1.07E-11
Selenium	2.13E-04	6.97E-03	1.25E-03	8.71E-06	1.07E-03	1.08E-03	1.65E-07	7.77E-08
Silver	2.21E-06	7.22E-05	2.00E-02	1.44E-06	1.11E-05	1.25E-05	1.92E-09	9.02E-10
Thallium	2.15E-07	7.01E-06	2.00E-04	1.40E-09	1.08E-06	1.08E-06	1.65E-10	7.76E-11

Table 8B-14

Average Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Resident-A Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	4.39E-14	5.69E-13	3.68E+00	2.09E-12	3.13E-15	2.09E-12	1.11E-15	2.63E-15
Aldrin	4.66E-16	6.03E-15	1.19E-04	7.18E-19	3.32E-17	3.39E-17	1.80E-20	4.26E-20
Atrazine	1.03E-16	1.39E-17	6.51E-02	9.06E-19	7.36E-18	8.27E-18	4.39E-21	1.04E-20
Benzaldehyde	9.54E-12	1.23E-10	3.23E-01	3.99E-11	6.79E-13	4.06E-11	2.15E-14	5.11E-14
Benzofuran	1.83E-11	2.37E-10	6.60E-02	1.56E-11	1.30E-12	1.69E-11	8.99E-15	2.13E-14
Benzoic Acid	4.62E-12	5.98E-11	1.92E-01	1.15E-11	3.29E-13	1.18E-11	6.27E-15	1.49E-14
Benzonitrile	4.39E-15	5.69E-14	2.91E-01	1.65E-14	3.13E-16	1.68E-14	8.93E-18	2.12E-17
Carbazole	8.79E-16	1.14E-14	2.88E-02	3.28E-16	6.26E-17	3.91E-16	2.07E-19	4.91E-19
4-Chlorobiphenyl	5.31E-12	6.88E-11	3.36E-03	2.31E-13	3.78E-13	6.09E-13	3.23E-16	7.66E-16
4,4-Chlorobiphenyl	6.96E-14	9.01E-13	1.35E-03	1.22E-15	4.95E-15	6.17E-15	3.27E-18	7.76E-18
4-Chlorophenylmethylsulfone	1.70E-15	4.58E-16	4.70E-01	2.15E-16	1.21E-16	3.36E-16	1.78E-19	4.22E-19
4-Chlorophenylmethylsulfoxide	6.32E-15	1.70E-15	3.95E-01	6.73E-16	4.50E-16	1.12E-15	5.96E-19	1.41E-18
p,p-DDE	7.74E-13	1.87E-12	1.17E-03	2.19E-15	5.51E-14	5.73E-14	3.04E-17	7.21E-17
p,p-DDT	1.55E-16	3.75E-16	4.78E-04	1.79E-19	1.10E-17	1.12E-17	5.95E-21	1.41E-20
Dibenzofuran	9.14E-13	1.18E-11	9.52E-03	1.13E-13	6.51E-14	1.78E-13	9.43E-17	2.24E-16
Dieldrin	9.56E-17	1.24E-15	5.92E-04	7.32E-19	6.81E-18	7.54E-18	4.00E-21	9.48E-21
Diisopropyl Methylphosphonate	1.68E-14	9.06E-15	2.32E-01	2.10E-15	1.20E-15	3.29E-15	1.75E-18	4.14E-18
1,3-Dimethylbenzene	1.83E-12	2.37E-11	3.25E-02	7.71E-13	1.30E-13	9.01E-13	4.78E-16	1.13E-15
Dimethyl Methylphosphonate	4.00E-13	3.57E-15	2.87E+01	1.03E-13	2.85E-14	1.31E-13	6.95E-17	1.65E-16
Dimethylphosphate	1.10E-13	1.42E-12			7.82E-15	7.82E-15	4.15E-18	9.83E-18
Dioxins/Furans (EPA TEFs)	2.80E-13	8.91E-13	6.76E-04	6.03E-16	2.00E-14	2.06E-14	1.09E-17	2.59E-17
Dithiane	1.68E-17	2.17E-16	8.35E-01	1.81E-16	1.20E-18	1.83E-16	9.69E-20	2.30E-19
Endrin	9.29E-17	2.49E-16	5.29E-03	1.32E-18	6.62E-18	7.93E-18	4.21E-21	9.98E-21
Hexachlorobenzene	3.12E-14	5.05E-14	1.57E-03	7.92E-17	2.22E-15	2.30E-15	1.22E-18	2.90E-18
Hexachlorocyclopentadiene	8.66E-16	1.12E-14	1.49E-03	1.67E-17	6.17E-17	7.83E-17	4.15E-20	9.85E-20
Isodrin	2.45E-16	3.17E-15	3.91E-04	1.24E-18	1.74E-17	1.87E-17	9.91E-21	2.35E-20
Malathion	3.74E-16	4.84E-15	4.92E-02	2.38E-16	2.66E-17	2.65E-16	1.40E-19	3.33E-19
Methanol	1.06E-11	1.38E-10	6.98E+00	9.60E-10	7.56E-13	9.60E-10	5.09E-13	1.21E-12
4-Nitrophenol	3.87E-15	5.01E-14	4.79E-02	2.40E-15	2.76E-16	2.68E-15	1.42E-18	3.36E-18
PAHs								
Acenaphthalene	4.58E-12	5.93E-11	1.02E-02	6.03E-13	3.26E-13	9.30E-13	4.93E-16	1.17E-15
Acenaphthene	4.58E-12	5.93E-11	1.24E-02	7.37E-13	3.26E-13	1.06E-12	5.64E-16	1.34E-15
Benzo(a)pyrene	9.14E-13	2.09E-13	4.41E-04	9.20E-17	6.51E-14	6.52E-14	3.46E-17	8.20E-17
Chrysene	9.14E-13	2.61E-13	1.02E-03	2.67E-16	6.51E-14	6.54E-14	3.47E-17	8.22E-17
Dibenzo(a,h)anthracene	9.14E-13	2.84E-13	3.96E-04	1.12E-16	6.51E-14	6.52E-14	3.46E-17	8.20E-17
Fluoranthene	2.75E-12	7.65E-13	2.19E-03	1.68E-15	1.96E-13	1.97E-13	1.05E-16	2.48E-16
Fluorene	9.14E-13	1.18E-11	6.73E-03	7.96E-14	6.51E-14	1.45E-13	7.68E-17	1.82E-16
Phenanthrene	1.83E-12	3.62E-13	5.22E-03	1.89E-15	1.30E-13	1.32E-13	7.01E-17	1.66E-16
Pyrene	9.14E-13	1.76E-13	2.31E-03	4.05E-16	6.51E-14	6.55E-14	3.47E-17	8.24E-17
Parathion	5.16E-17	6.68E-16	1.44E-02	9.62E-18	3.68E-18	1.33E-17	7.05E-21	1.67E-20
Pentachlorobenzene	1.40E-14	1.81E-13	2.64E-03	4.78E-16	9.95E-16	1.47E-15	7.81E-19	1.85E-18
Phenol	4.96E-11	6.42E-10	3.32E-01	2.13E-10	3.53E-12	2.17E-10	1.15E-13	2.72E-13
Quinoline	2.19E-15	2.83E-14	1.55E-01	4.39E-15	1.56E-16	4.55E-15	2.41E-18	5.72E-18

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12/2' '90

Table 8B-14
(continued)

Supona	1.55E-16	2.01E-15	3.67E-02	7.36E-17	1.10E-17	8.46E-17	4.49E-20	1.06E-19
Tetrachlorobenzene	5.89E-15	7.63E-14	6.82E-03	5.20E-16	4.20E-16	9.39E-16	4.98E-19	1.18E-18
Trichlorobenzene	3.10E-15	4.02E-14	1.15E-02	4.61E-16	2.21E-16	6.82E-16	3.62E-19	8.58E-19
Urea	6.71E-11	8.69E-10	1.23E+02	1.07E-07	4.78E-12	1.07E-07	5.68E-11	1.35E-10
Vapona	4.13E-16	5.35E-15	3.60E-01	1.93E-15	2.94E-17	1.95E-15	1.04E-18	2.46E-18
INORGANICS								
Antimony	4.26E-08	5.52E-07	1.80E-03	9.94E-10	3.04E-09	4.03E-09	2.14E-12	5.07E-12
Arsenic	2.41E-07	3.12E-06	3.60E-04	1.12E-09	1.72E-08	1.83E-08	9.71E-12	2.30E-11
Barium	5.91E-08	7.65E-07	9.00E-04	6.89E-10	4.21E-09	4.90E-09	2.60E-12	6.16E-12
Beryllium	2.47E-09	3.20E-08	9.00E-05	2.88E-12	1.76E-10	1.79E-10	9.47E-14	2.25E-13
Copper	2.26E-04	2.93E-03	1.50E-02	4.39E-05	1.61E-05	6.01E-05	3.18E-08	7.55E-08
Lead	7.57E-08	9.81E-07	5.40E-04	5.29E-10	5.39E-09	5.92E-09	3.14E-12	7.45E-12
Mercury	6.68E-08	8.64E-07	1.20E-02	1.04E-08	4.75E-09	1.51E-08	8.02E-12	1.90E-11
Selenium	6.19E-04	8.01E-03	1.50E-03	1.20E-05	4.41E-05	5.61E-05	2.98E-08	7.05E-08
Silver	6.41E-06	8.30E-05	6.00E-03	4.98E-07	4.57E-07	9.55E-07	5.06E-10	1.20E-09
Thallium	6.23E-07	8.06E-06	2.40E-05	1.93E-10	4.43E-08	4.45E-08	2.36E-11	5.60E-11

Table 8B-15

Average Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Resident-B Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	6.16E-15	8.23E-13	3.68E+00	3.02E-12	4.38E-16	3.02E-12	1.60E-15	3.80E-15
Aldrin	6.52E-17	8.72E-15	1.19E-04	1.04E-18	4.65E-18	5.68E-18	3.01E-21	7.15E-21
Atrazine	1.45E-17	2.01E-17	6.51E-02	1.31E-18	1.03E-18	2.34E-18	1.24E-21	2.94E-21
Benzaldehyde	1.34E-12	1.79E-10	3.23E-01	5.77E-11	9.52E-14	5.78E-11	3.07E-14	7.27E-14
Benzofuran	2.56E-12	3.43E-10	6.60E-02	2.26E-11	1.83E-13	2.28E-11	1.21E-14	2.87E-14
Benzoic Acid	6.47E-13	8.65E-11	1.92E-01	1.66E-11	4.61E-14	1.67E-11	8.83E-15	2.09E-14
Benzonitrile	6.16E-16	8.23E-14	2.91E-01	2.39E-14	4.38E-17	2.39E-14	1.27E-17	3.01E-17
Carbazole	1.23E-16	1.65E-14	2.88E-02	4.74E-16	8.77E-18	4.83E-16	2.56E-19	6.07E-19
4-Chlorobiphenyl	7.44E-13	9.94E-11	3.36E-03	3.34E-13	5.30E-14	3.87E-13	2.05E-16	4.86E-16
4,4-Chlorobiphenyl	9.75E-15	1.30E-12	1.35E-03	1.76E-15	6.94E-16	2.46E-15	1.30E-18	3.09E-18
4-Chlorophenylmethylsulfone	2.38E-16	6.62E-16	4.70E-01	3.11E-16	1.69E-17	3.28E-16	1.74E-19	4.12E-19
4-Chlorophenylmethylsulfoxide	8.86E-16	2.46E-15	3.95E-01	9.73E-16	6.31E-17	1.04E-15	5.49E-19	1.30E-18
p,p-DDE	1.08E-13	2.70E-12	1.17E-03	3.16E-15	7.72E-15	1.09E-14	5.77E-18	1.37E-17
p,p-DDT	2.17E-17	5.41E-16	4.78E-04	2.59E-19	1.55E-18	1.81E-18	9.57E-22	2.27E-21
Dibenzofuran	1.28E-13	1.71E-11	9.52E-03	1.63E-13	9.12E-15	1.72E-13	9.12E-17	2.16E-16
Dieldrin	1.34E-17	1.79E-15	5.92E-04	1.06E-18	9.53E-19	2.01E-18	1.07E-21	2.53E-21
Diisopropyl Methylphosphonate	2.35E-15	1.31E-14	2.32E-01	3.03E-15	1.68E-16	3.20E-15	1.70E-18	4.02E-18
1,3-Dimethylbenzene	2.56E-13	3.43E-11	3.25E-02	1.11E-12	1.83E-14	1.13E-12	6.01E-16	1.42E-15
Dimethyl Methylphosphonate	5.61E-14	5.16E-15	2.87E+01	1.48E-13	3.99E-15	1.52E-13	8.08E-17	1.91E-16
Dimethylphosphate	1.54E-14	2.05E-12			1.10E-15	1.10E-15	5.81E-19	1.38E-18
Dioxins/Furans (EPA TEFs)	3.93E-14	1.29E-12	6.76E-04	8.71E-16	2.80E-15	3.67E-15	1.95E-18	4.61E-18
Dithiane	2.35E-18	3.14E-16	8.35E-01	2.62E-16	1.68E-19	2.63E-16	1.39E-19	3.30E-19
Endrin	1.30E-17	3.59E-16	5.29E-03	1.90E-18	9.27E-19	2.83E-18	1.50E-21	3.56E-21
Hexachlorobenzene	4.38E-15	7.30E-14	1.57E-03	1.15E-16	3.12E-16	4.26E-16	2.26E-19	5.36E-19
Hexachlorocyclopentadiene	1.21E-16	1.62E-14	1.49E-03	2.41E-17	8.64E-18	3.27E-17	1.74E-20	4.12E-20
Isodrin	3.43E-17	4.59E-15	3.91E-04	1.79E-18	2.44E-18	4.24E-18	2.25E-21	5.33E-21
Malathion	5.24E-17	7.00E-15	4.92E-02	3.44E-16	3.73E-18	3.48E-16	1.85E-19	4.38E-19
Methanol	1.49E-12	1.99E-10	6.98E+00	1.39E-09	1.06E-13	1.39E-09	7.36E-13	1.74E-12
4-Nitrophenol	5.42E-16	7.25E-14	4.79E-02	3.47E-15	3.86E-17	3.51E-15	1.86E-18	4.41E-18
PAHs								
Acenaphthalene	6.42E-13	8.58E-11	1.02E-02	8.72E-13	4.57E-14	9.18E-13	4.87E-16	1.15E-15
Acenaphthene	6.42E-13	8.58E-11	1.24E-02	1.07E-12	4.57E-14	1.11E-12	5.90E-16	1.40E-15
Benzo(a)pyrene	1.28E-13	3.01E-13	4.41E-04	1.33E-16	9.12E-15	9.26E-15	4.91E-18	1.16E-17
Chrysene	1.28E-13	3.78E-13	1.02E-03	3.86E-16	9.12E-15	9.51E-15	5.04E-18	1.20E-17
Dibenzo(a,h)anthracene	1.28E-13	4.10E-13	3.96E-04	1.63E-16	9.12E-15	9.29E-15	4.92E-18	1.17E-17
Fluoranthene	3.85E-13	1.11E-12	2.19E-03	2.42E-15	2.74E-14	2.99E-14	1.58E-17	3.75E-17
Fluorene	1.28E-13	1.71E-11	6.73E-03	1.15E-13	9.12E-15	1.24E-13	6.59E-17	1.56E-16
Phenanthrene	2.56E-13	5.24E-13	5.22E-03	2.73E-15	1.83E-14	2.10E-14	1.11E-17	2.64E-17
Pyrene	1.28E-13	2.54E-13	2.31E-03	5.86E-16	9.12E-15	9.71E-15	5.15E-18	1.22E-17
Parathion	7.23E-18	9.66E-16	1.44E-02	1.39E-17	5.15E-19	1.44E-17	7.65E-21	1.81E-20
Pentachlorobenzene	1.96E-15	2.61E-13	2.64E-03	6.90E-16	1.39E-16	8.30E-16	4.40E-19	1.04E-18
Phenol	6.94E-12	9.28E-10	3.32E-01	3.08E-10	4.94E-13	3.09E-10	1.64E-13	3.88E-13
Quinoline	3.07E-16	4.10E-14	1.55E-01	6.35E-15	2.18E-17	6.37E-15	3.38E-18	8.01E-18

Table 8B-15
(continued)

Supona	2.17E-17	2.90E-15	3.67E-02	1.06E-16	1.55E-18	1.08E-16	5.72E-20	1.36E-19
Tetrachlorobenzene	8.25E-16	1.10E-13	6.82E-03	7.51E-16	5.88E-17	8.10E-16	4.30E-19	1.02E-18
Trichlorobenzene	4.35E-16	5.81E-14	1.15E-02	6.67E-16	3.10E-17	6.98E-16	3.70E-19	8.77E-19
Urea	9.41E-12	1.26E-09	1.23E+02	1.55E-07	6.70E-13	1.55E-07	8.21E-11	1.95E-10
Vapona	5.79E-17	7.74E-15	3.60E-01	2.78E-15	4.12E-18	2.79E-15	1.48E-18	3.50E-18
INORGANICS								
Antimony	5.97E-09	7.98E-07	1.80E-03	1.44E-09	4.25E-10	1.86E-09	9.87E-13	2.34E-12
Arsenic	3.38E-08	4.52E-06	3.60E-04	1.63E-09	2.41E-09	4.03E-09	2.14E-12	5.07E-12
Barium	8.28E-09	1.11E-06	9.00E-04	9.95E-10	5.90E-10	1.59E-09	8.41E-13	1.99E-12
Beryllium	3.46E-10	4.62E-08	9.00E-05	4.16E-12	2.46E-11	2.88E-11	1.53E-14	3.62E-14
Copper	3.17E-05	4.24E-03	1.50E-02	6.35E-05	2.26E-06	6.58E-05	3.49E-08	8.27E-08
Lead	1.06E-08	1.42E-06	5.40E-04	7.65E-10	7.56E-10	1.52E-09	8.07E-13	1.91E-12
Mercury	9.35E-09	1.25E-06	1.20E-02	1.50E-08	6.66E-10	1.57E-08	8.30E-12	1.97E-11
Selenium	8.67E-05	1.16E-02	1.50E-03	1.74E-05	6.18E-06	2.36E-05	1.25E-08	2.96E-08
Silver	8.99E-07	1.20E-04	6.00E-03	7.20E-07	6.40E-08	7.84E-07	4.16E-10	9.86E-10
Thallium	8.72E-08	1.17E-05	2.40E-05	2.80E-10	6.21E-09	6.49E-09	3.44E-12	8.16E-12

Table 8B-16

Average Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Farmer Location

	DRY DEPOSITION RATE g/M2/yr	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CONC.DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	AVERAGE CONC ON PLANT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	1.52E-14	4.88E-13	3.68E+00	1.79E-12	1.08E-15	1.79E-12	1.48E-15	3.50E-15
Aldrin	1.61E-16	5.17E-15	1.19E-04	6.16E-19	1.14E-17	1.21E-17	9.92E-21	2.35E-20
Atrazine	3.57E-17	1.19E-17	6.51E-02	7.77E-19	2.54E-18	3.32E-18	2.73E-21	6.47E-21
Benzaldehyde	3.29E-12	1.06E-10	3.23E-01	3.42E-11	2.34E-13	3.45E-11	2.84E-14	6.72E-14
Benzofuran	6.31E-12	2.03E-10	6.60E-02	1.34E-11	4.50E-13	1.39E-11	1.14E-14	2.70E-14
Benzoic Acid	1.59E-12	5.13E-11	1.92E-01	9.85E-12	1.13E-13	9.96E-12	8.20E-15	1.94E-14
Benzonitrile	1.52E-15	4.88E-14	2.91E-01	1.42E-14	1.08E-16	1.43E-14	1.18E-17	2.79E-17
Carbazole	3.03E-16	9.75E-15	2.88E-02	2.81E-16	2.16E-17	3.03E-16	2.49E-19	5.91E-19
4-Chlorobiphenyl	1.83E-12	5.89E-11	3.36E-03	1.98E-13	1.30E-13	3.28E-13	2.70E-16	6.41E-16
4,4-Chlorobiphenyl	2.40E-14	7.72E-13	1.35E-03	1.05E-15	1.71E-15	2.75E-15	2.27E-18	5.37E-18
4-Chlorophenylmethylsulfone	5.86E-16	3.92E-16	4.70E-01	1.84E-16	4.17E-17	2.26E-16	1.86E-19	4.41E-19
4-Chlorophenylmethylsulfoxide	2.18E-15	1.46E-15	3.95E-01	5.77E-16	1.55E-16	7.32E-16	6.02E-19	1.43E-18
p,p-DDE	2.67E-13	1.60E-12	1.17E-03	1.87E-15	1.90E-14	2.09E-14	1.72E-17	4.08E-17
p,p-DDT	5.35E-17	3.21E-16	4.78E-04	1.53E-19	3.81E-18	3.96E-18	3.26E-21	7.73E-21
Dibenzofuran	3.15E-13	1.01E-11	9.52E-03	9.66E-14	2.25E-14	1.19E-13	9.80E-17	2.32E-16
Dieldrin	3.30E-17	1.06E-15	5.92E-04	6.27E-19	2.35E-18	2.97E-18	2.45E-21	5.80E-21
Diisopropyl Methylphosphonate	5.79E-15	7.76E-15	2.32E-01	1.80E-15	4.12E-16	2.21E-15	1.82E-18	4.31E-18
1,3-Dimethylbenzene	6.31E-13	2.03E-11	3.25E-02	6.61E-13	4.50E-14	7.06E-13	5.81E-16	1.38E-15
Dimethyl Methylphosphonate	1.38E-13	3.06E-15	2.87E+01	8.79E-14	9.83E-15	9.77E-14	8.04E-17	1.91E-16
Dimethylphosphate	3.79E-14	1.22E-12			2.70E-15	2.70E-15	2.22E-18	5.26E-18
Dioxins/Furans (EPA TEFs)	9.68E-14	7.64E-13	6.76E-04	5.16E-16	6.89E-15	7.41E-15	6.09E-18	1.45E-17
Dithiane	5.79E-18	1.86E-16	8.35E-01	1.56E-16	4.12E-19	1.56E-16	1.28E-19	3.04E-19
Endrin	3.21E-17	2.13E-16	5.29E-03	1.13E-18	2.28E-18	3.41E-18	2.81E-21	6.65E-21
Hexachlorobenzene	1.08E-14	4.33E-14	1.57E-03	6.79E-17	7.67E-16	8.35E-16	6.87E-19	1.63E-18
Hexachlorocyclopentadiene	2.99E-16	9.61E-15	1.49E-03	1.43E-17	2.13E-17	3.56E-17	2.93E-20	6.94E-20
Isodrin	8.45E-17	2.72E-15	3.91E-04	1.06E-18	6.02E-18	7.08E-18	5.83E-21	1.38E-20
Malathion	1.29E-16	4.15E-15	4.92E-02	2.04E-16	9.19E-18	2.13E-16	1.76E-19	4.16E-19
Methanol	3.66E-12	1.18E-10	6.98E+00	8.22E-10	2.61E-13	8.23E-10	6.77E-13	1.61E-12
4-Nitrophenol	1.34E-15	4.30E-14	4.79E-02	2.06E-15	9.51E-17	2.15E-15	1.77E-18	4.20E-18
PAHs								
Acenaphthalene	1.58E-12	5.08E-11	1.02E-02	5.17E-13	1.13E-13	6.30E-13	5.18E-16	1.23E-15
Acenaphthene	1.58E-12	5.08E-11	1.24E-02	6.32E-13	1.13E-13	7.45E-13	6.13E-16	1.45E-15
Benzo(a)pyrene	3.15E-13	1.79E-13	4.41E-04	7.89E-17	2.25E-14	2.25E-14	1.85E-17	4.40E-17
Chrysene	3.15E-13	2.24E-13	1.02E-03	2.29E-16	2.25E-14	2.27E-14	1.87E-17	4.43E-17
Dibenzo(a,h)anthracene	3.15E-13	2.43E-13	3.96E-04	9.64E-17	2.25E-14	2.26E-14	1.86E-17	4.40E-17
Fluoranthene	9.48E-13	6.56E-13	2.19E-03	1.44E-15	6.75E-14	6.90E-14	5.67E-17	1.35E-16
Fluorene	3.15E-13	1.01E-11	6.73E-03	6.82E-14	2.25E-14	9.07E-14	7.46E-17	1.77E-16
Phenanthrene	6.31E-13	3.10E-13	5.22E-03	1.62E-15	4.50E-14	4.66E-14	3.83E-17	9.09E-17
Pyrene	3.15E-13	1.50E-13	2.31E-03	3.47E-16	2.25E-14	2.28E-14	1.88E-17	4.45E-17
Parathion	1.78E-17	5.73E-16	1.44E-02	8.25E-18	1.27E-18	9.51E-18	7.83E-21	1.86E-20
Pentachlorobenzene	4.82E-15	1.55E-13	2.64E-03	4.09E-16	3.43E-16	7.52E-16	6.19E-19	1.47E-18
Phenol	1.71E-11	5.50E-10	3.32E-01	1.83E-10	1.22E-12	1.84E-10	1.51E-13	3.59E-13
Quinoline	7.55E-16	2.43E-14	1.55E-01	3.77E-15	5.37E-17	3.82E-15	3.14E-18	7.45E-18

Table 8B-16
(continued)

Supona	5.35E-17	1.72E-15	3.67E-02	6.31E-17	3.81E-18	6.69E-17	5.50E-20	1.31E-19
Tetrachlorobenzene	2.03E-15	6.54E-14	6.82E-03	4.46E-16	1.45E-16	5.90E-16	4.86E-19	1.15E-18
Trichlorobenzene	1.07E-15	3.44E-14	1.15E-02	3.95E-16	7.63E-17	4.71E-16	3.88E-19	9.20E-19
Urea	2.32E-11	7.45E-10	1.23E+02	9.18E-08	1.65E-12	9.18E-08	7.55E-11	1.79E-10
Vapona	1.43E-16	4.59E-15	3.60E-01	1.65E-15	1.02E-17	1.66E-15	1.37E-18	3.24E-18
INORGANICS								
Antimony	1.47E-08	4.73E-07	1.80E-03	8.52E-10	1.05E-09	1.90E-09	1.56E-12	3.70E-12
Arsenic	8.32E-08	2.68E-06	3.60E-04	9.64E-10	5.93E-09	6.89E-09	5.67E-12	1.34E-11
Barium	2.04E-08	6.56E-07	9.00E-04	5.90E-10	1.45E-09	2.04E-09	1.68E-12	3.98E-12
Beryllium	8.51E-10	2.74E-08	9.00E-05	2.47E-12	6.06E-11	6.31E-11	5.19E-14	1.23E-13
Copper	7.80E-05	2.51E-03	1.50E-02	3.77E-05	5.56E-06	4.32E-05	3.56E-08	8.43E-08
Lead	2.61E-08	8.40E-07	5.40E-04	4.54E-10	1.86E-09	2.31E-09	1.90E-12	4.51E-12
Mercury	2.30E-08	7.41E-07	1.20E-02	8.89E-09	1.64E-09	1.05E-08	8.66E-12	2.05E-11
Selenium	2.13E-04	6.87E-03	1.50E-03	1.03E-05	1.52E-05	2.55E-05	2.10E-08	4.98E-08
Silver	2.21E-06	7.12E-05	6.00E-03	4.27E-07	1.58E-07	5.85E-07	4.81E-10	1.14E-09
Thallium	2.15E-07	6.91E-06	2.40E-05	1.66E-10	1.53E-08	1.55E-08	1.27E-11	3.02E-11

Table 8B-17

Maximum Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Resident-A Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC.DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	4.39E-14	5.77E-13	3.68E+00	2.12E-12	1.10E-13	2.23E-12	1.18E-15	2.80E-15
Aldrin	4.66E-16	6.12E-15	1.19E-04	7.29E-19	1.16E-15	1.16E-15	6.16E-19	1.46E-18
Atrazine	1.03E-16	4.57E-16	6.51E-02	2.98E-17	2.58E-16	2.88E-16	1.52E-19	3.61E-19
Benzaldehyde	9.54E-12	1.25E-10	3.23E-01	4.05E-11	2.38E-11	6.43E-11	3.41E-14	8.08E-14
Benzofuran	1.83E-11	2.40E-10	6.60E-02	1.59E-11	4.56E-11	6.15E-11	3.26E-14	7.73E-14
Benzoic Acid	4.62E-12	6.07E-11	1.92E-01	1.17E-11	1.15E-11	2.32E-11	1.23E-14	2.91E-14
Benzonitrile	4.39E-15	5.77E-14	2.91E-01	1.68E-14	1.10E-14	2.77E-14	1.47E-17	3.49E-17
Carbazole	8.79E-16	1.15E-14	2.88E-02	3.33E-16	2.19E-15	2.52E-15	1.34E-18	3.17E-18
4-Chlorobiphenyl	5.31E-12	6.98E-11	3.36E-03	2.34E-13	1.32E-11	1.35E-11	7.14E-15	1.69E-14
4,4-Chlorobiphenyl	6.96E-14	9.14E-13	1.35E-03	1.24E-15	1.73E-13	1.75E-13	9.26E-17	2.20E-16
4-Chlorophenylmethylsulfone	1.70E-15	1.20E-14	4.70E-01	5.64E-15	4.23E-15	9.88E-15	5.24E-18	1.24E-17
4-Chlorophenylmethylsulfoxide	6.32E-15	4.47E-14	3.95E-01	1.77E-14	1.58E-14	3.34E-14	1.77E-17	4.20E-17
p,p-DDE	7.74E-13	9.39E-12	1.17E-03	1.10E-14	1.93E-12	1.94E-12	1.03E-15	2.44E-15
p,p-DDT	1.55E-16	1.88E-15	4.78E-04	8.99E-19	3.86E-16	3.87E-16	2.05E-19	4.87E-19
Dibenzofuran	9.14E-13	1.20E-11	9.52E-03	1.14E-13	2.28E-12	2.39E-12	1.27E-15	3.01E-15
Dieldrin	9.56E-17	1.26E-15	5.92E-04	7.43E-19	2.38E-16	2.39E-16	1.27E-19	3.00E-19
Diisopropyl Methylphosphonate	1.68E-14	1.59E-13	2.32E-01	3.67E-14	4.19E-14	7.86E-14	4.17E-17	9.88E-17
1,3-Dimethylbenzene	1.83E-12	2.40E-11	3.25E-02	7.82E-13	4.56E-12	5.35E-12	2.83E-15	6.72E-15
Dimethyl Methylphosphonate	4.00E-13	1.25E-13	2.87E+01	3.59E-12	9.97E-13	4.59E-12	2.43E-15	5.77E-15
Dimethylphosphate	1.10E-13	1.44E-12			2.74E-13	2.74E-13	1.45E-16	3.44E-16
Dioxins/Furans (EPA TEFs)	2.80E-13	3.47E-12	6.76E-04	2.34E-15	6.99E-13	7.02E-13	3.72E-16	8.82E-16
Dithiane	1.68E-17	2.21E-16	8.35E-01	1.84E-16	4.19E-17	2.26E-16	1.20E-19	2.84E-19
Endrin	9.29E-17	1.14E-15	5.29E-03	6.01E-18	2.32E-16	2.38E-16	1.26E-19	2.99E-19
Hexachlorobenzene	3.12E-14	3.65E-13	1.57E-03	5.72E-16	7.78E-14	7.84E-14	4.16E-17	9.86E-17
Hexachlorocyclopentadiene	8.66E-16	1.14E-14	1.49E-03	1.69E-17	2.16E-15	2.18E-15	1.15E-18	2.73E-18
Isodrin	2.45E-16	3.22E-15	3.91E-04	1.26E-18	6.11E-16	6.12E-16	3.24E-19	7.69E-19
Malathion	3.74E-16	4.91E-15	4.92E-02	2.42E-16	9.32E-16	1.17E-15	6.22E-19	1.48E-18
Methanol	1.06E-11	1.40E-10	6.98E+00	9.73E-10	2.65E-11	1.00E-09	5.30E-13	1.26E-12
4-Nitrophenol	3.87E-15	5.08E-14	4.79E-02	2.44E-15	9.65E-15	1.21E-14	6.41E-18	1.52E-17
PAHs								
Acenaphthalene	4.58E-12	6.02E-11	1.02E-02	6.12E-13	1.14E-11	1.20E-11	6.38E-15	1.51E-14
Acenaphthene	4.58E-12	6.02E-11	1.24E-02	7.48E-13	1.14E-11	1.22E-11	6.45E-15	1.53E-14
Benzo(a)pyrene	9.14E-13	5.88E-12	4.41E-04	2.59E-15	2.28E-12	2.28E-12	1.21E-15	2.87E-15
Chrysene	9.14E-13	6.67E-12	1.02E-03	6.83E-15	2.28E-12	2.29E-12	1.21E-15	2.87E-15
Dibenzo(a,h)anthracene	9.14E-13	6.95E-12	3.96E-04	2.76E-15	2.28E-12	2.28E-12	1.21E-15	2.87E-15
Fluoranthene	2.75E-12	1.98E-11	2.19E-03	4.33E-14	6.85E-12	6.90E-12	3.66E-15	8.67E-15
Fluorene	9.14E-13	1.20E-11	6.73E-03	8.08E-14	2.28E-12	2.36E-12	1.25E-15	2.97E-15
Phenanthrene	1.83E-12	1.08E-11	5.22E-03	5.61E-14	4.56E-12	4.62E-12	2.45E-15	5.81E-15
Pyrene	9.14E-13	5.27E-12	2.31E-03	1.22E-14	2.28E-12	2.29E-12	1.22E-15	2.88E-15
Parathion	5.16E-17	6.78E-16	1.44E-02	9.76E-18	1.29E-16	1.38E-16	7.34E-20	1.74E-19
Pentachlorobenzene	1.40E-14	1.83E-13	2.64E-03	4.84E-16	3.48E-14	3.53E-14	1.87E-17	4.44E-17
Phenol	4.96E-11	6.51E-10	3.32E-01	2.16E-10	1.24E-10	3.40E-10	1.80E-13	4.27E-13
Quinoline	2.19E-15	2.87E-14	1.55E-01	4.46E-15	5.45E-15	9.91E-15	5.26E-18	1.25E-17

Table 8B-17
(continued)

Supona	1.55E-16	2.04E-15	3.67E-02	7.47E-17	3.86E-16	4.61E-16	2.45E-19	5.80E-19
Tetrachlorobenzene	5.89E-15	7.74E-14	6.82E-03	5.27E-16	1.47E-14	1.52E-14	8.07E-18	1.91E-17
Trichlorobenzene	3.10E-15	4.08E-14	1.15E-02	4.68E-16	7.74E-15	8.21E-15	4.35E-18	1.03E-17
Urea	6.71E-11	8.82E-10	1.23E+02	1.09E-07	1.67E-10	1.09E-07	5.77E-11	1.37E-10
Vapona	4.13E-16	5.43E-15	3.60E-01	1.95E-15	1.03E-15	2.98E-15	1.58E-18	3.75E-18
INORGANICS								
Antimony	4.26E-08	5.60E-07	1.80E-03	1.01E-09	1.06E-07	1.07E-07	5.69E-11	1.35E-10
Arsenic	2.41E-07	3.17E-06	3.60E-04	1.14E-09	6.01E-07	6.02E-07	3.19E-10	7.57E-10
Barium	5.91E-08	7.76E-07	9.00E-04	6.99E-10	1.47E-07	1.48E-07	7.85E-11	1.86E-10
Beryllium	2.47E-09	3.24E-08	9.00E-05	2.92E-12	6.15E-09	6.16E-09	3.26E-12	7.74E-12
Copper	2.26E-04	2.97E-03	1.50E-02	4.46E-05	5.64E-04	6.09E-04	3.23E-07	7.65E-07
Lead	7.57E-08	9.95E-07	5.40E-04	5.37E-10	1.89E-07	1.89E-07	1.00E-10	2.38E-10
Mercury	6.68E-08	8.77E-07	1.20E-02	1.05E-08	1.66E-07	1.77E-07	9.38E-11	2.22E-10
Selenium	6.19E-04	8.13E-03	1.50E-03	1.22E-05	1.54E-03	1.56E-03	8.25E-07	1.96E-06
Silver	6.41E-06	8.42E-05	6.00E-03	5.05E-07	1.60E-05	1.65E-05	8.75E-09	2.07E-08
Thallium	6.23E-07	8.18E-06	2.40E-05	1.96E-10	1.55E-06	1.55E-06	8.23E-10	1.95E-09

Table 8B-18

Maximum Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Resident-B Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC.DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	6.16E-15	8.34E-13	3.68E+00	3.07E-12	1.53E-14	3.08E-12	1.63E-15	3.88E-15
Aldrin	6.52E-17	8.84E-15	1.19E-04	1.05E-18	1.63E-16	1.64E-16	8.68E-20	2.06E-19
Atrazine	1.45E-17	6.60E-16	6.51E-02	4.30E-17	3.61E-17	7.91E-17	4.20E-20	9.95E-20
Benzaldehyde	1.34E-12	1.81E-10	3.23E-01	5.86E-11	3.33E-12	6.19E-11	3.28E-14	7.78E-14
Benzofuran	2.56E-12	3.48E-10	6.60E-02	2.29E-11	6.39E-12	2.93E-11	1.56E-14	3.69E-14
Benzoic Acid	6.47E-13	8.77E-11	1.92E-01	1.68E-11	1.61E-12	1.85E-11	9.79E-15	2.32E-14
Benzonitrile	6.16E-16	8.34E-14	2.91E-01	2.42E-14	1.53E-15	2.58E-14	1.37E-17	3.24E-17
Carbazole	1.23E-16	1.67E-14	2.88E-02	4.81E-16	3.07E-16	7.88E-16	4.18E-19	9.91E-19
4-Chlorobiphenyl	7.44E-13	1.01E-10	3.36E-03	3.39E-13	1.85E-12	2.19E-12	1.16E-15	2.76E-15
4,4-Chlorobiphenyl	9.75E-15	1.32E-12	1.35E-03	1.79E-15	2.43E-14	2.61E-14	1.38E-17	3.28E-17
4-Chlorophenylmethylsulfone	2.38E-16	1.74E-14	4.70E-01	8.16E-15	5.93E-16	8.76E-15	4.64E-18	1.10E-17
4-Chlorophenylmethylsulfoxide	8.86E-16	6.46E-14	3.95E-01	2.55E-14	2.21E-15	2.77E-14	1.47E-17	3.49E-17
p,p-DDE	1.08E-13	1.36E-11	1.17E-03	1.59E-14	2.70E-13	2.86E-13	1.52E-16	3.60E-16
p,p-DDT	2.17E-17	2.72E-15	4.78E-04	1.30E-18	5.41E-17	5.54E-17	2.94E-20	6.97E-20
Dibenzofuran	1.28E-13	1.74E-11	9.52E-03	1.65E-13	3.19E-13	4.85E-13	2.57E-16	6.09E-16
Dieldrin	1.34E-17	1.81E-15	5.92E-04	1.07E-18	3.34E-17	3.44E-17	1.83E-20	4.33E-20
Diisopropyl Methylphosphonate	2.35E-15	2.29E-13	2.32E-01	5.31E-14	5.86E-15	5.89E-14	3.12E-17	7.41E-17
1,3-Dimethylbenzene	2.56E-13	3.48E-11	3.25E-02	1.13E-12	6.39E-13	1.77E-12	9.38E-16	2.23E-15
Dimethyl Methylphosphonate	5.61E-14	1.81E-13	2.87E+01	5.19E-12	1.40E-13	5.33E-12	2.83E-15	6.70E-15
Dimethylphosphate	1.54E-14	2.08E-12			3.83E-14	3.83E-14	2.03E-17	4.82E-17
Dioxins/Furans (EPA TEFs)	3.93E-14	5.01E-12	6.76E-04	3.39E-15	9.80E-14	1.01E-13	5.37E-17	1.27E-16
Dithiane	2.35E-18	3.19E-16	8.35E-01	2.66E-16	5.86E-18	2.72E-16	1.44E-19	3.42E-19
Endrin	1.30E-17	1.64E-15	5.29E-03	8.68E-18	3.25E-17	4.11E-17	2.18E-20	5.17E-20
Hexachlorobenzene	4.38E-15	5.28E-13	1.57E-03	8.27E-16	1.09E-14	1.17E-14	6.22E-18	1.48E-17
Hexachlorocyclopentadiene	1.21E-16	1.64E-14	1.49E-03	2.44E-17	3.02E-16	3.27E-16	1.73E-19	4.11E-19
Isodrin	3.43E-17	4.65E-15	3.91E-04	1.82E-18	8.56E-17	8.74E-17	4.63E-20	1.10E-19
Malathion	5.24E-17	7.10E-15	4.92E-02	3.49E-16	1.31E-16	4.80E-16	2.55E-19	6.03E-19
Methanol	1.49E-12	2.02E-10	6.98E+00	1.41E-09	3.71E-12	1.41E-09	7.48E-13	1.77E-12
4-Nitrophenol	5.42E-16	7.35E-14	4.79E-02	3.52E-15	1.35E-15	4.87E-15	2.58E-18	6.13E-18
PAHs								
Acenaphthalene	6.42E-13	8.70E-11	1.02E-02	8.85E-13	1.60E-12	2.49E-12	1.32E-15	3.12E-15
Acenaphthene	6.42E-13	8.70E-11	1.24E-02	1.08E-12	1.60E-12	2.68E-12	1.42E-15	3.37E-15
Benzo(a)pyrene	1.28E-13	8.50E-12	4.41E-04	3.75E-15	3.19E-13	3.23E-13	1.71E-16	4.06E-16
Chrysene	1.28E-13	9.64E-12	1.02E-03	9.87E-15	3.19E-13	3.29E-13	1.75E-16	4.14E-16
Dibenzo(a,h)anthracene	1.28E-13	1.01E-11	3.96E-04	3.98E-15	3.19E-13	3.23E-13	1.71E-16	4.07E-16
Fluoranthene	3.85E-13	2.86E-11	2.19E-03	6.26E-14	9.60E-13	1.02E-12	5.42E-16	1.29E-15
Fluorene	1.28E-13	1.74E-11	6.73E-03	1.17E-13	3.19E-13	4.36E-13	2.31E-16	5.48E-16
Phenanthrene	2.56E-13	1.56E-11	5.22E-03	8.11E-14	6.39E-13	7.20E-13	3.82E-16	9.06E-16
Pyrene	1.28E-13	7.61E-12	2.31E-03	1.76E-14	3.19E-13	3.37E-13	1.79E-16	4.24E-16
Parathion	7.23E-18	9.80E-16	1.44E-02	1.41E-17	1.80E-17	3.21E-17	1.70E-20	4.04E-20
Pentachlorobenzene	1.96E-15	2.65E-13	2.64E-03	7.00E-16	4.88E-15	5.58E-15	2.96E-18	7.01E-18
Phenol	6.94E-12	9.41E-10	3.32E-01	3.13E-10	1.73E-11	3.30E-10	1.75E-13	4.15E-13
Quinoline	3.07E-16	4.15E-14	1.55E-01	6.44E-15	7.64E-16	7.21E-15	3.82E-18	9.06E-18

Table 8B-18
(continued)

Supona	2.17E-17	2.94E-15	3.67E-02	1.08E-16	5.41E-17	1.62E-16	8.59E-20	2.04E-19
Tetrachlorobenzene	8.25E-16	1.12E-13	6.82E-03	7.62E-16	2.06E-15	2.82E-15	1.50E-18	3.54E-18
Trichlorobenzene	4.35E-16	5.89E-14	1.15E-02	6.76E-16	1.08E-15	1.76E-15	9.34E-19	2.21E-18
Urea	9.41E-12	1.27E-09	1.23E+02	1.57E-07	2.34E-11	1.57E-07	8.33E-11	1.98E-10
Vapona	5.79E-17	7.85E-15	3.60E-01	2.82E-15	1.44E-16	2.97E-15	1.57E-18	3.73E-18
INORGANICS								
Antimony	5.97E-09	8.10E-07	1.80E-03	1.46E-09	1.49E-08	1.63E-08	8.67E-12	2.06E-11
Arsenic	3.38E-08	4.58E-06	3.60E-04	1.65E-09	8.42E-08	8.59E-08	4.55E-11	1.08E-10
Barium	8.28E-09	1.12E-06	9.00E-04	1.01E-09	2.06E-08	2.16E-08	1.15E-11	2.72E-11
Beryllium	3.46E-10	4.69E-08	9.00E-05	4.22E-12	8.62E-10	8.66E-10	4.59E-13	1.09E-12
Copper	3.17E-05	4.30E-03	1.50E-02	6.44E-05	7.90E-05	1.43E-04	7.61E-08	1.80E-07
Lead	1.06E-08	1.44E-06	5.40E-04	7.77E-10	2.64E-08	2.72E-08	1.44E-11	3.42E-11
Mercury	9.35E-09	1.27E-06	1.20E-02	1.52E-08	2.33E-08	3.85E-08	2.04E-11	4.84E-11
Selenium	8.67E-05	1.18E-02	1.50E-03	1.76E-05	2.16E-04	2.34E-04	1.24E-07	2.94E-07
Silver	8.99E-07	1.22E-04	6.00E-03	7.31E-07	2.24E-06	2.97E-06	1.58E-09	3.74E-09
Thallium	8.72E-08	1.18E-05	2.40E-05	2.84E-10	2.17E-07	2.18E-07	1.15E-10	2.74E-10

Table 8B-19

Maximum Pollutant Concentration in Tomatoes, and Adult and Child Daily Intake at the Farmer Location

	DRY DEPOSITION RATE g/M2/yr	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC ON PLANT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS								
Acetonitrile	1.52E-14	4.95E-13	3.68E+00	1.82E-12	3.78E-14	1.86E-12	1.53E-15	3.62E-15
Aldrin	1.61E-16	5.24E-15	1.19E-04	6.25E-19	4.00E-16	4.01E-16	3.30E-19	7.82E-19
Atrazine	3.57E-17	3.92E-16	6.51E-02	2.55E-17	8.89E-17	1.14E-16	9.41E-20	2.23E-19
Benzaldehyde	3.29E-12	1.07E-10	3.23E-01	3.47E-11	8.20E-12	4.29E-11	3.53E-14	8.37E-14
Benzofuran	6.31E-12	2.06E-10	6.60E-02	1.36E-11	1.57E-11	2.93E-11	2.41E-14	5.72E-14
Benzoic Acid	1.59E-12	5.20E-11	1.92E-01	9.99E-12	3.97E-12	1.40E-11	1.15E-14	2.72E-14
Benzonitrile	1.52E-15	4.95E-14	2.91E-01	1.44E-14	3.78E-15	1.82E-14	1.49E-17	3.54E-17
Carbazole	3.03E-16	9.89E-15	2.88E-02	2.85E-16	7.56E-16	1.04E-15	8.57E-19	2.03E-18
4-Chlorobiphenyl	1.83E-12	5.98E-11	3.36E-03	2.01E-13	4.57E-12	4.77E-12	3.92E-15	9.30E-15
4,4-Chlorobiphenyl	2.40E-14	7.83E-13	1.35E-03	1.06E-15	5.98E-14	6.09E-14	5.01E-17	1.19E-16
4-Chlorophenylmethylsulfone	5.86E-16	1.03E-14	4.70E-01	4.84E-15	1.46E-15	6.30E-15	5.18E-18	1.23E-17
4-Chlorophenylmethylsulfoxide	2.18E-15	3.83E-14	3.95E-01	1.51E-14	5.43E-15	2.06E-14	1.69E-17	4.01E-17
p,p-DDE	2.67E-13	8.05E-12	1.17E-03	9.41E-15	6.66E-13	6.75E-13	5.55E-16	1.32E-15
p,p-DDT	5.35E-17	1.61E-15	4.78E-04	7.70E-19	1.33E-16	1.34E-16	1.10E-19	2.62E-19
Dibenzofuran	3.15E-13	1.03E-11	9.52E-03	9.80E-14	7.86E-13	8.84E-13	7.28E-16	1.72E-15
Dieldrin	3.30E-17	1.08E-15	5.92E-04	6.37E-19	8.22E-17	8.28E-17	6.81E-20	1.62E-19
Diisopropyl Methylphosphonate	5.79E-15	1.36E-13	2.32E-01	3.14E-14	1.44E-14	4.59E-14	3.78E-17	8.95E-17
1,3-Dimethylbenzene	6.31E-13	2.06E-11	3.25E-02	6.70E-13	1.57E-12	2.24E-12	1.85E-15	4.38E-15
Dimethyl Methylphosphonate	1.38E-13	1.07E-13	2.87E+01	3.08E-12	3.44E-13	3.42E-12	2.82E-15	6.68E-15
Dimethylphosphate	3.79E-14	1.24E-12			9.44E-14	9.44E-14	7.77E-17	1.84E-16
Dioxins/Furans (EPA TEFs)	9.68E-14	2.97E-12	6.76E-04	2.01E-15	2.41E-13	2.43E-13	2.00E-16	4.74E-16
Dithiane	5.79E-18	1.89E-16	8.35E-01	1.58E-16	1.44E-17	1.72E-16	1.42E-19	3.36E-19
Endrin	3.21E-17	9.73E-16	5.29E-03	5.15E-18	7.99E-17	8.51E-17	7.00E-20	1.66E-19
Hexachlorobenzene	1.08E-14	3.13E-13	1.57E-03	4.91E-16	2.68E-14	2.73E-14	2.25E-17	5.33E-17
Hexachlorocyclopentadiene	2.99E-16	9.75E-15	1.49E-03	1.45E-17	7.44E-16	7.59E-16	6.24E-19	1.48E-18
Isodrin	8.45E-17	2.76E-15	3.91E-04	1.08E-18	2.11E-16	2.12E-16	1.74E-19	4.13E-19
Malathion	1.29E-16	4.21E-15	4.92E-02	2.07E-16	3.22E-16	5.29E-16	4.35E-19	1.03E-18
Methanol	3.66E-12	1.20E-10	6.98E+00	8.34E-10	9.13E-12	8.43E-10	6.94E-13	1.65E-12
4-Nitrophenol	1.34E-15	4.36E-14	4.79E-02	2.09E-15	3.33E-15	5.42E-15	4.46E-18	1.06E-17
PAHs								
Acenaphthalene	1.58E-12	5.16E-11	1.02E-02	5.25E-13	3.94E-12	4.46E-12	3.67E-15	8.71E-15
Acenaphthene	1.58E-12	5.16E-11	1.24E-02	6.41E-13	3.94E-12	4.58E-12	3.77E-15	8.94E-15
Benzo(a)pyrene	3.15E-13	5.04E-12	4.41E-04	2.22E-15	7.86E-13	7.88E-13	6.49E-16	1.54E-15
Chrysene	3.15E-13	5.72E-12	1.02E-03	5.85E-15	7.86E-13	7.92E-13	6.52E-16	1.55E-15
Dibenzo(a,h)anthracene	3.15E-13	5.96E-12	3.96E-04	2.36E-15	7.86E-13	7.89E-13	6.49E-16	1.54E-15
Fluoranthene	9.48E-13	1.70E-11	2.19E-03	3.71E-14	2.36E-12	2.40E-12	1.98E-15	4.68E-15
Fluorene	3.15E-13	1.03E-11	6.73E-03	6.92E-14	7.86E-13	8.55E-13	7.04E-16	1.67E-15
Phenanthrene	6.31E-13	9.22E-12	5.22E-03	4.81E-14	1.57E-12	1.62E-12	1.33E-15	3.16E-15
Pyrene	3.15E-13	4.51E-12	2.31E-03	1.04E-14	7.86E-13	7.97E-13	6.55E-16	1.55E-15
Parathion	1.78E-17	5.81E-16	1.44E-02	8.37E-18	4.44E-17	5.27E-17	4.34E-20	1.03E-19
Pentachlorobenzene	4.82E-15	1.57E-13	2.64E-03	4.15E-16	1.20E-14	1.24E-14	1.02E-17	2.42E-17
Phenol	1.71E-11	5.58E-10	3.32E-01	1.85E-10	4.26E-11	2.28E-10	1.88E-13	4.45E-13
Quinoline	7.55E-16	2.46E-14	1.55E-01	3.82E-15	1.88E-15	5.70E-15	4.69E-18	1.11E-17

Table 8B-18
(continued)

Supona	5.35E-17	1.75E-15	3.67E-02	6.40E-17	1.33E-16	1.97E-16	1.62E-19	3.85E-19
Tetrachlorobenzene	2.03E-15	6.63E-14	6.82E-03	4.52E-16	5.06E-15	5.52E-15	4.54E-18	1.08E-17
Trichlorobenzene	1.07E-15	3.49E-14	1.15E-02	4.01E-16	2.67E-15	3.07E-15	2.53E-18	5.99E-18
Urea	2.32E-11	7.56E-10	1.23E+02	9.31E-08	5.77E-11	9.32E-08	7.67E-11	1.82E-10
Vapona	1.43E-16	4.65E-15	3.60E-01	1.67E-15	3.55E-16	2.03E-15	1.67E-18	3.96E-18
INORGANICS								
Antimony	1.47E-08	4.80E-07	1.80E-03	8.64E-10	3.67E-08	3.75E-08	3.09E-11	7.32E-11
Arsenic	8.32E-08	2.72E-06	3.60E-04	9.78E-10	2.07E-07	2.08E-07	1.71E-10	4.07E-10
Barium	2.04E-08	6.65E-07	9.00E-04	5.99E-10	5.08E-08	5.14E-08	4.23E-11	1.00E-10
Beryllium	8.51E-10	2.78E-08	9.00E-05	2.50E-12	2.12E-09	2.12E-09	1.75E-12	4.15E-12
Copper	7.80E-05	2.55E-03	1.50E-02	3.82E-05	1.95E-04	2.33E-04	1.92E-07	4.54E-07
Lead	2.61E-08	8.53E-07	5.40E-04	4.60E-10	6.51E-08	6.56E-08	5.40E-11	1.28E-10
Mercury	2.30E-08	7.52E-07	1.20E-02	9.02E-09	5.74E-08	6.64E-08	5.47E-11	1.30E-10
Selenium	2.13E-04	6.97E-03	1.50E-03	1.05E-05	5.32E-04	5.43E-04	4.46E-07	1.06E-06
Silver	2.21E-06	7.22E-05	6.00E-03	4.33E-07	5.51E-06	5.95E-06	4.89E-09	1.16E-08
Thallium	2.15E-07	7.01E-06	2.40E-05	1.68E-10	5.35E-07	5.36E-07	4.41E-10	1.04E-09

In the case of the carrot, which is a modified taproot, the translocation distance is minimal, and the concentration predicted for the edible portion is essentially the root concentration (see preceding subsection). In the case of tomatoes and lettuce, where the edible portions (leaves in lettuce, fruit in tomatoes) are above ground, the potential for transport from the roots to the aerial portions of the plant also has to be considered.

The pollutant concentration (C_u) in the edible portions of tomato and lettuce plants resulting from uptake from the soil is expressed by the following equation:

$$C_u \text{ (mg/kg)} = \text{Pollutant concentration in soil (mg/kg)} \times \text{PUF}$$

Where:

PUF = Plant uptake factor (unitless).

The potential for the translocation of pollutants to aboveground plant parts varies considerably with the nature of the pollutant and the plant. The subsection that follows addresses the translocation potentials for the pollutants of concern and derives uptake factors for those that might potentially accumulate at significant concentrations.

Organics

Travis and Arms (1988) presented the following relationship between the log K_{ow} and the plant uptake factor:

$$\text{PUF} = 38.9\, K_{ow}^{-0.58}$$

The uptake factors calculated by using the preceding equation were converted from dry weight to wet weight by assuming that lettuce and tomatoes have water contents of 95 and 94 percent, respectively (Baes et al., 1984).

The calculated PUFs for the pollutants of concern are presented in Tables 8B-8 through 8B-13 (lettuce) and Tables 8B-14 through 8B-19 (tomatoes).

Inorganics

The potential for the translocation of inorganics from roots to the aerial parts of the plants is influenced by numerous factors. These include the presence of chelating ligands (carriers), pH, oxidation-reduction state, competing cations, hydrolysis, polymerization, and the formation of insoluble salts (Kabata-Pendias and Pendias, 1985). However, a general distinction can be made between those inorganics that are easily translocated and those that tend to remain in the roots.

The uptake factors used for the inorganic compounds in tomatoes are based on transfer coefficients developed by Baes et al. (1984) for fruit. Tomatoes, although commonly referred to as vegetables, are actually fruit. The uptake factors used for inorganics in lettuce are based on the transfer coefficients developed by Baes et al. (1984) for vegetative parts of plants, since the edible parts of the lettuce are the leaves. The coefficients developed by Baes et al. (1984) were converted from dry weight to wet weight by assuming that lettuce and tomatoes have water contents of 95 and 94 percent, respectively. The uptake factors for the inorganic compounds are presented in Tables 8B-8 through 8B-13 (lettuce) and Tables 8B-14 through 8B-19 (tomatoes).

Average concentrations of pollutants in lettuce and average daily intakes are summarized for the adult and child for the Resident-A, Resident-B, and the Farmer exposure scenarios in Tables 8B-8, 8B-9, and 8B-10, respectively. Maximum lettuce concentrations and maximum daily intakes are presented in Tables 8B-11, 8B-12, and 8B-13. Average concentrations of pollutants in tomatoes and average daily intakes are summarized for the adult and child for the Resident-A, Resident-B, and Farmer, exposure scenarios in Tables 8B-14, 8B-15, and 8B-16, respectively. Maximum tomato concentrations and maximum daily intakes are presented in Tables 8B-17, 8B-18, and 8B-19.

APPENDIX 8B

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APPENDIX 8C

METHODOLOGY FOR DETERMINING POLLUTANT UPTAKE THROUGH MILK AND BEEF CONSUMPTION

APPENDIX 8C

METHODOLOGY FOR DETERMINING POLLUTANT UPTAKE THROUGH MILK AND BEEF CONSUMPTION

8C.1 INTRODUCTION

The calculation of pollutant intakes via the consumption of dairy and beef products involves a number of steps:

- Calculation of the pollutant concentration in locally grown cattle feed resulting from surface deposition and uptake from contaminated soil.
- Calculation of the concentration of the pollutant in the products (milk, beef).
- Prediction of daily intake of dairy and beef products by humans.

This appendix will address all of these issues.

8C.2 CONCENTRATIONS RESULTING FROM PLANT UPTAKE

The methodology used in calculating pollutant concentrations in cattle feed through plant uptake from soil was the same as that described for garden vegetables, and is described by the equation:

$$C_{plant} = (C_{soil}) (PUF)$$

Where:

C_{plant} = Pollutant concentration in plant resulting from root uptake (mg/kg).

C_{soil} = Pollutant concentration in soil (mg/kg).

PUF = Plant uptake factor, the ratio between pollutant concentration in soil and plant (unitless).

It was assumed that hay, grain, and corn are grown in fields that are regularly tilled; therefore, soil pollutant concentrations were based on a 20-cm mixing depth. The contaminant soil concentrations are based on deposition at the Farmer scenario location over the 2-year life of the incinerator and are calculated as described in Appendix 8A. As discussed in Subsection 8.1.1, for all scenarios, a farm is assumed to be located in the area of highest deposition and air concentration where cows were observed grazing.

8C.2.1 Inorganics

Plant uptake factors were derived for antimony, arsenic, barium, beryllium, copper, lead, mercury, selenium, silver, and thallium. These are the inorganics that have been identified as contributing greater than 1 percent of background concentrations.

The uptake factors that were used for antimony in corn silage and hay were derived by dividing the antimony concentrations that have been reported in corn grain and grass, respectively, by a mean concentration for antimony reported in soils (Kabata-Pendias and Pendias, 1985). A transfer coefficient developed by Baes et al. (1984) for reproductive portions of plants was used as the uptake factor for antimony in grain.

The arsenic uptake factors for grain were based on data reported for barley grain, (Kabata-Pendias and Pendias, 1985). The uptake factors for arsenic by hay and corn are presented in NRCC (1978).

The barium uptake factor used for hay was derived by dividing the mean barium concentration reported in alfalfa hay, by a mean concentration for barium reported in

soil. A transfer coefficient developed by Baes et al. (1984) for reproductive portions of plants was used as the uptake factor for barium in grain and corn silage.

A transfer coefficient developed by Baes et al. (1984) for reproductive portions of plants was used as the uptake factor for beryllium in grain and corn silage. Baes et al. (1984) also developed a transfer coefficient for vegetative portions of plants for beryllium, which was used as the uptake factor for hay.

For copper, uptake factors in hay and grain were based on data reported for pasture herbage and barley grain, respectively (Kabata-Pendias and Pendias, 1985). An uptake factor for corn silage was derived by dividing the mean copper concentration in corn grain by a mean soil concentration (Kabata-Pendias and Pendias, 1985).

The uptake factors that were used for lead in grain, corn silage, and hay were derived by dividing mean lead concentrations in wheat grain, corn grain, and clover, respectively, by a mean lead concentration reported in soils (Kabata-Pendias and Pendias, 1985).

Uptake factors for mercury in corn silage and hay were derived by dividing the mean mercury concentration in corn grain and alfalfa by a mean mercury concentration in soils (Kabata-Pendias and Pendias, 1985). A transfer coefficient for mercury developed for the reproductive parts of plants was used as an uptake factor for mercury in grain (Baes et al., 1984).

Uptake factors for selenium in corn silage and hay were based on data reported for corn and rye grass, respectively (Kabata-Pendias and Pendias, 1985). A transfer coefficient for selenium developed for reproductive parts of plants was used as an uptake factor for selenium in grain (Baes et al., 1984).

Transfer coefficients developed by Baes et al. (1984) for silver and thallium, based on reproductive portions of plants, were used as uptake factors for silver and thallium in grain and corn silage. Baes et al. (1984) also developed transfer coefficients for

vegetative portions of plants for silver and thallium, which were used as uptake factors for hay. The uptake factors are presented in Tables 8C-1, 8C-2, and 8C-3 for grain, hay, and corn silage, respectively, along with pollutant concentrations for these feeds.

8C.2.2 Organics

Plant uptake factors for organic compounds were calculated using the same methodology as that described for tomatoes and lettuce, and are expressed by the following equation developed by Travis and Arms (1988):

$$PUF = 38.9\ K_{ow}^{-0.58}$$

8C.3 CONCENTRATION FROM SURFACE DEPOSITION

The concentrations of pollutants in cattle feed resulting from surface deposition (C_d) were calculated using equations similar to those used for lettuce and tomatoes in Appendix 8B:

$$C_d \text{ (maximum)} = (DR)(SDF)$$

$$C_d \text{ (average)} = (DR)(SDF)(2/70)$$

Where:

DR = Pollutant dry deposition rate (mg/m^2s). This includes only dry deposition. Pollutants falling on plant surfaces from wet deposition are washed off the plant and are incorporated into the soil.

SDF = Surface deposition factor (m^2s/kg).

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Table 8C-1

Average and Maximum Pollutant Concentration in Grain at the Farm Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	PLANT UPTAKE FACTOR	AVERAGE CALCULATED CONC. IN GRAIN mg/Kg	MAXIMUM CALCULATED CONC. IN GRAIN mg/Kg
ORGANICS					
Acetonitrile	4.88E-13	4.95E-13	6.13E+01	2.99E-11	3.03E-11
Aldrin	5.17E-15	5.24E-15	1.99E-03	1.03E-17	1.04E-17
Atrazine	1.19E-17	3.92E-16	1.09E+00	1.29E-17	4.25E-16
Benzaldehyde	1.06E-10	1.07E-10	5.39E+00	5.70E-10	5.79E-10
Benzofuran	2.03E-10	2.06E-10	1.10E+00	2.23E-10	2.27E-10
Benzoic Acid	5.13E-11	5.20E-11	3.20E+00	1.64E-10	1.66E-10
Benzonitrile	4.88E-14	4.95E-14	4.84E+00	2.36E-13	2.40E-13
Carbazole	9.75E-15	9.89E-15	4.81E-01	4.69E-15	4.76E-15
4-Chlorobiphenyl	5.89E-11	5.98E-11	5.60E-02	3.30E-12	3.35E-12
4,4-Chlorobiphenyl	7.72E-13	7.83E-13	2.26E-02	1.74E-14	1.77E-14
4-Chlorophenylmethylsulfone	3.92E-16	1.03E-14	7.83E+00	3.07E-15	8.07E-14
4-Chlorophenylmethylsulfoxide	1.46E-15	3.83E-14	6.58E+00	9.61E-15	2.52E-13
p,p-DDE	1.60E-12	8.05E-12	1.95E-02	3.12E-14	1.57E-13
p,p-DDT	3.21E-16	1.61E-15	7.96E-03	2.56E-18	1.28E-17
Dibenzofuran	1.01E-11	1.03E-11	1.59E-01	1.61E-12	1.63E-12
Dieldrin	1.06E-15	1.08E-15	9.86E-03	1.05E-17	1.06E-17
Diisopropyl Methylphosphonate	7.76E-15	1.36E-13	3.86E+00	3.00E-14	5.24E-13
1,3-Dimethylbenzene	2.03E-11	2.06E-11	5.42E-01	1.10E-11	1.12E-11
Dimethyl Methylphosphonate	3.06E-15	1.07E-13	4.79E+02	1.47E-12	5.13E-11
Dimethylphosphate	1.22E-12	1.24E-12			
Dioxins/Furans (EPA TEFs)	7.64E-13	2.97E-12	1.13E-02	8.61E-15	3.35E-14
Dithiane	1.86E-16	1.89E-16	1.39E+01	2.59E-15	2.63E-15
Endrin	2.13E-16	9.73E-16	8.81E-02	1.88E-17	8.58E-17
Hexachlorobenzene	4.33E-14	3.13E-13	2.61E-02	1.13E-15	8.18E-15
Hexachlorocyclopentadiene	9.61E-15	9.75E-15	2.48E-02	2.38E-16	2.42E-16
Isodrin	2.72E-15	2.76E-15	6.52E-03	1.77E-17	1.80E-17
Malathion	4.15E-15	4.21E-15	8.20E-01	3.40E-15	3.45E-15
Methanol	1.18E-10	1.20E-10	1.16E+02	1.37E-08	1.39E-08
4-Nitrophenol	4.30E-14	4.36E-14	7.98E-01	3.43E-14	3.48E-14
PAHs					
Acenaphthalene	5.08E-11	5.16E-11	1.70E-01	8.62E-12	8.75E-12
Acenaphthene	5.08E-11	5.16E-11	2.07E-01	1.05E-11	1.07E-11
Benzo(a)pyrene	1.79E-13	5.04E-12	7.35E-03	1.31E-15	3.71E-14
Chrysene	2.24E-13	5.72E-12	1.71E-02	3.82E-15	9.75E-14
Dibenzo(a,h)anthracene	2.43E-13	5.96E-12	6.61E-03	1.61E-15	3.94E-14
Fluoranthene	6.56E-13	1.70E-11	3.65E-02	2.39E-14	6.19E-13
Fluorene	1.01E-11	1.03E-11	1.12E-01	1.14E-12	1.15E-12
Phenanthrene	3.10E-13	9.22E-12	8.70E-02	2.70E-14	8.02E-13
Pyrene	1.50E-13	4.51E-12	3.85E-02	5.79E-15	1.74E-13
Parathion	5.73E-16	5.81E-16	2.40E-01	1.37E-16	1.39E-16
Pentachlorobenzene	1.55E-13	1.57E-13	4.40E-02	6.82E-15	6.92E-15
Phenol	5.50E-10	5.58E-10	5.54E+00	3.04E-09	3.09E-09
Quinoline	2.43E-14	2.46E-14	2.59E+00	6.28E-14	6.37E-14
Supona	1.72E-15	1.75E-15	6.11E-01	1.05E-15	1.07E-15
Tetrachlorobenzene	6.54E-14	6.63E-14	1.14E-01	7.43E-15	7.53E-15

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Table 8C-1
(Continued)

Trichlorobenzene	3.44E-14	3.49E-14	1.91E-01	6.59E-15	6.68E-15
Urea	7.45E-10	7.56E-10	2.05E+03	1.53E-06	1.55E-06
Vapona	4.59E-15	4.65E-15	6.00E+00	2.75E-14	2.79E-14
INORGANICS					
Antimony	4.73E-07	4.80E-07	3.00E-02	1.42E-08	1.44E-08
Arsenic	2.68E-06	2.72E-06	3.30E-03	8.83E-09	8.96E-09
Barium	6.56E-07	6.65E-07	1.50E-02	9.84E-09	9.98E-09
Beryllium	2.74E-08	2.78E-08	1.50E-03	4.11E-11	4.17E-11
Copper	2.51E-03	2.55E-03	1.70E-01	4.27E-04	4.33E-04
Lead	8.40E-07	8.53E-07	2.46E-02	2.07E-08	2.10E-08
Mercury	7.41E-07	7.52E-07	2.00E-01	1.48E-07	1.50E-07
Selenium	6.87E-03	6.97E-03	2.50E-02	1.72E-04	1.74E-04
Silver	7.12E-05	7.22E-05	1.00E-01	7.12E-06	7.22E-06
Thallium	6.91E-06	7.01E-06	4.00E-04	2.76E-09	2.80E-09

Table 8C-2

Average and Maximum Pollutant Concentration in Hay at the Farm Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	DRY DEPOSITION RATE g/M2/yr	PLANT UPTAKE FACTOR	AVERAGE CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	AVERAGE CALCULATED CONC IN HAY mg/Kg	MAXIMUM CALCULATED CONC IN HAY mg/Kg
ORGANICS										
Acetonitrile	4.88E-13	4.95E-13	1.52E-14	6.13E+01	2.99E-11	3.03E-11	3.42E-14	1.20E-12	2.99E-11	3.15E-11
Aldrin	5.17E-15	5.24E-15	1.61E-16	1.99E-03	1.03E-17	1.04E-17	3.62E-16	1.27E-14	3.73E-16	1.27E-14
Atrazine	1.19E-17	3.92E-16	3.57E-17	1.09E+00	1.29E-17	4.25E-16	8.05E-17	2.82E-15	9.34E-17	3.24E-15
Benzaldehyde	1.06E-10	1.07E-10	3.29E-12	5.39E+00	5.70E-10	5.79E-10	7.42E-12	2.60E-10	5.78E-10	8.38E-10
Benzofuran	2.03E-10	2.06E-10	6.31E-12	1.10E+00	2.23E-10	2.27E-10	1.43E-11	4.99E-10	2.38E-10	7.25E-10
Benzoic Acid	5.13E-11	5.20E-11	1.59E-12	3.20E+00	1.64E-10	1.66E-10	3.60E-12	1.26E-10	1.68E-10	2.92E-10
Benzonitrile	4.88E-14	4.95E-14	1.52E-15	4.84E+00	2.36E-13	2.40E-13	3.42E-15	1.20E-13	2.40E-13	3.59E-13
Carbazole	9.75E-15	9.89E-15	3.03E-16	4.81E-01	4.69E-15	4.76E-15	6.84E-16	2.39E-14	5.37E-15	2.87E-14
4-Chlorobiphenyl	5.89E-11	5.98E-11	1.83E-12	5.60E-02	3.30E-12	3.35E-12	4.13E-12	1.45E-10	7.43E-12	1.48E-10
4,4-Chlorobiphenyl	7.72E-13	7.83E-13	2.40E-14	2.26E-02	1.74E-14	1.77E-14	5.41E-14	1.90E-12	7.16E-14	1.91E-12
4-Chlorophenylmethylsulfone	3.92E-16	1.03E-14	5.86E-16	7.83E+00	3.07E-15	8.07E-14	1.32E-15	4.63E-14	4.39E-15	1.27E-13
4-Chlorophenylmethylsulfoxide	1.46E-15	3.83E-14	2.18E-15	6.58E+00	9.61E-15	2.52E-13	4.92E-15	1.72E-13	1.45E-14	4.25E-13
p,p-DDE	1.60E-12	8.05E-12	2.67E-13	1.95E-02	3.12E-14	1.57E-13	6.03E-13	2.11E-11	6.34E-13	2.12E-11
p,p-DDT	3.21E-16	1.61E-15	5.35E-17	7.96E-03	2.56E-18	1.28E-17	1.21E-16	4.22E-15	1.23E-16	4.24E-15
Dibenzofuran	1.01E-11	1.03E-11	3.15E-13	1.59E-01	1.61E-12	1.63E-12	7.12E-13	2.49E-11	2.32E-12	2.65E-11
Dieldrin	1.06E-15	1.08E-15	3.30E-17	9.86E-03	1.05E-17	1.06E-17	7.44E-17	2.60E-15	8.48E-17	2.61E-15
Diisopropyl Methylphosphonate	7.76E-15	1.36E-13	5.79E-15	3.86E+00	3.00E-14	5.24E-13	1.31E-14	4.57E-13	4.30E-14	9.82E-13
1,3-Dimethylbenzene	2.03E-11	2.06E-11	6.31E-13	5.42E-01	1.10E-11	1.12E-11	1.43E-12	4.99E-11	1.24E-11	6.10E-11
Dimethyl Methylphosphonate	3.06E-15	1.07E-13	1.38E-13	4.79E+02	1.47E-12	5.13E-11	3.12E-13	1.09E-11	1.78E-12	6.22E-11
Dimethylphosphate	1.22E-12	1.24E-12	3.79E-14				8.54E-14	2.99E-12	8.54E-14	2.99E-12
Dioxine/Furans (EPA TEFs)	7.64E-13	2.97E-12	9.68E-14	1.13E-02	8.61E-15	3.35E-14	2.18E-13	7.64E-12	2.27E-13	7.68E-12
Dithiane	1.86E-16	1.89E-16	5.79E-18	1.39E+01	2.59E-15	2.63E-15	1.31E-17	4.57E-16	2.61E-15	3.09E-15
Endrin	2.13E-16	9.73E-16	3.21E-17	8.81E-02	1.88E-17	8.58E-17	7.23E-17	2.53E-15	9.11E-17	2.62E-15
Hexachlorobenzene	4.33E-14	3.13E-13	1.08E-14	2.61E-02	1.13E-15	8.18E-15	2.43E-14	8.51E-13	2.54E-14	8.59E-13
Hexachlorocyclopentadiene	9.61E-15	9.75E-15	2.99E-16	2.48E-02	2.38E-16	2.42E-16	6.74E-16	2.36E-14	9.12E-16	2.38E-14
Isodrin	2.72E-15	2.76E-15	8.45E-17	6.52E-03	1.77E-17	1.80E-17	1.91E-16	6.67E-15	2.08E-16	6.69E-15
Malathion	4.15E-15	4.21E-15	1.29E-16	8.20E-01	3.40E-15	3.45E-15	2.91E-16	1.02E-14	3.69E-15	1.36E-14
Methanol	1.18E-10	1.20E-10	3.66E-12	1.16E+02	1.37E-08	1.39E-08	8.27E-12	2.89E-10	1.37E-08	1.42E-08
4-Nitrophenol	4.30E-14	4.36E-14	1.34E-15	7.98E-01	3.43E-14	3.48E-14	3.01E-15	1.05E-13	3.73E-14	1.40E-13
PAHs										
Acenaphthalene	5.08E-11	5.16E-11	1.58E-12	1.70E-01	8.62E-12	8.75E-12	3.57E-12	1.25E-10	1.22E-11	1.34E-10
Acenaphthene	5.08E-11	5.16E-11	1.58E-12	2.07E-01	1.05E-11	1.07E-11	3.57E-12	1.25E-10	1.41E-11	1.36E-10
Benzo(a)pyrene	1.79E-13	5.04E-12	3.15E-13	7.35E-03	1.31E-15	3.71E-14	7.12E-13	2.49E-11	7.13E-13	2.49E-11
Chrysene	2.24E-13	5.72E-12	3.15E-13	1.71E-02	3.82E-15	9.75E-14	7.12E-13	2.49E-11	7.16E-13	2.50E-11
Dibenzo(a,h)anthracene	2.43E-13	5.96E-12	3.15E-13	6.61E-03	1.61E-15	3.94E-14	7.12E-13	2.49E-11	7.13E-13	2.50E-11
Fluoranthene	6.56E-13	1.70E-11	9.48E-13	3.65E-02	2.39E-14	6.19E-13	2.14E-12	7.49E-11	2.16E-12	7.55E-11
Fluorene	1.01E-11	1.03E-11	3.15E-13	1.12E-01	1.14E-12	1.15E-12	7.12E-13	2.49E-11	1.85E-12	2.61E-11
Phenanthrene	3.10E-13	9.22E-12	6.31E-13	8.70E-02	2.70E-14	8.02E-13	1.43E-12	4.99E-11	1.45E-12	5.07E-11
Pyrene	1.50E-13	4.51E-12	3.15E-13	3.85E-02	5.79E-15	1.74E-13	7.12E-13	2.49E-11	7.18E-13	2.51E-11
Parathion	5.73E-16	5.81E-16	1.78E-17	2.40E-01	1.37E-16	1.39E-16	4.02E-17	1.41E-15	1.78E-16	1.55E-15
Pentachlorobenzene	1.55E-13	1.57E-13	4.82E-15	4.40E-02	6.82E-15	6.92E-15	1.09E-14	3.81E-13	1.77E-14	3.87E-13
Phenol	5.50E-10	5.58E-10	1.71E-11	5.54E+00	3.04E-09	3.09E-09	3.86E-11	1.35E-09	3.08E-09	4.44E-09
Quinoline	2.43E-14	2.46E-14	7.55E-16	2.59E+00	6.28E-14	6.37E-14	1.70E-15	5.96E-14	6.45E-14	1.23E-13
Supona	1.72E-15	1.75E-15	5.35E-17	6.11E-01	1.05E-15	1.07E-15	1.21E-16	4.22E-15	1.17E-15	5.29E-15
Tetrachlorobenzene	6.54E-14	6.63E-14	2.03E-15	1.14E-01	7.43E-15	7.53E-15	4.59E-15	1.60E-13	1.20E-14	1.68E-13

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Table 8C-2
(Continued)

Trichlorobenzene	3.44E-14	3.49E-14	1.07E-15	1.91E-01	6.59E-15	6.68E-15	2.42E-15	8.46E-14	9.00E-15	9.13E-14
Urea	7.45E-10	7.56E-10	2.32E-11	2.05E+03	1.53E-06	1.55E-06	5.23E-11	1.83E-09	1.53E-06	1.55E-06
Vapona	4.59E-15	4.65E-15	1.43E-16	6.00E+00	2.75E-14	2.79E-14	3.22E-16	1.13E-14	2.78E-14	3.92E-14
INORGANICS										
Antimony	4.73E-07	4.80E-07	1.47E-08	2.90E-02	1.37E-08	1.39E-08	3.32E-08	1.16E-06	4.69E-08	1.18E-06
Arsenic	2.68E-06	2.72E-06	8.32E-08	2.00E-01	5.35E-07	5.43E-07	1.88E-07	6.57E-06	7.23E-07	7.12E-06
Barium	6.56E-07	6.65E-07	2.04E-08	1.60E-01	1.05E-07	1.06E-07	4.60E-08	1.61E-06	1.51E-07	1.72E-06
Beryllium	2.74E-08	2.78E-08	8.51E-10	1.00E-02	2.74E-10	2.78E-10	1.92E-09	6.72E-08	2.20E-09	6.75E-08
Copper	2.51E-03	2.55E-03	7.80E-05	5.00E-01	1.26E-03	1.27E-03	1.76E-04	6.16E-03	1.43E-03	7.44E-03
Lead	8.40E-07	8.53E-07	2.61E-08	7.70E-02	6.47E-08	6.57E-08	5.90E-08	2.06E-06	1.24E-07	2.13E-06
Mercury	7.41E-07	7.52E-07	2.30E-08	2.30E-01	1.70E-07	1.73E-07	5.20E-08	1.82E-06	2.22E-07	1.99E-06
Selenium	6.87E-03	6.97E-03	2.13E-04	2.00E-01	1.37E-03	1.39E-03	4.82E-04	1.69E-02	1.86E-03	1.83E-02
Silver	7.12E-05	7.22E-05	2.21E-06	4.00E-01	2.85E-05	2.89E-05	4.99E-06	1.75E-04	3.35E-05	2.04E-04
Thallium	6.91E-06	7.01E-06	2.15E-07	4.00E-03	2.76E-08	2.80E-08	4.85E-07	1.70E-05	5.12E-07	1.70E-05

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Table 8C-3

Average and Maximum Pollutant Concentration in Corn Silage at the Farm Location

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	DRY DEPOSITION RATE g/M2/yr	PLANT UPTAKE FACTOR	AVERAGE CONC. DUE TO UPTAKE mg/Kg	MAXIMUM CONC. DUE TO UPTAKE mg/Kg	AVERAGE CONC. ON PLANT SURFACE mg/Kg	MAXIMUM CONC. ON PLANT SURFACE mg/Kg	AVERAGE CALCULATED CONC IN CORN SILAGE mg/Kg	MAXIMUM CALCULATED CONC IN CORN SILAGE mg/Kg
ORGANICS										
Acetonitrile	4.88E-13	4.95E-13	1.52E-14	6.13E+01	2.99E-11	3.03E-11	5.81E-15	2.03E-13	2.99E-11	3.05E-11
Aldrin	5.17E-15	5.24E-15	1.61E-16	1.99E-03	1.03E-17	1.04E-17	6.15E-17	2.15E-15	7.18E-17	2.16E-15
Atrazine	1.19E-17	3.92E-16	3.57E-17	1.09E+00	1.29E-17	4.25E-16	1.37E-17	4.78E-16	2.66E-17	9.03E-16
Benzaldehyde	1.06E-10	1.07E-10	3.29E-12	5.39E+00	5.70E-10	5.79E-10	1.26E-12	4.41E-11	5.72E-10	6.23E-10
Benzofuran	2.03E-10	2.06E-10	6.31E-12	1.10E+00	2.23E-10	2.27E-10	2.42E-12	8.46E-11	2.26E-10	3.11E-10
Benzoic Acid	5.13E-11	5.20E-11	1.59E-12	3.20E+00	1.64E-10	1.66E-10	6.10E-13	2.14E-11	1.65E-10	1.88E-10
Benzonitrile	4.88E-14	4.95E-14	1.52E-15	4.84E+00	2.36E-13	2.40E-13	5.81E-16	2.03E-14	2.37E-13	2.60E-13
Carbazole	9.75E-15	9.89E-15	3.03E-16	4.81E-01	4.69E-15	4.76E-15	1.16E-16	4.06E-15	4.80E-15	8.82E-15
4-Chlorobiphenyl	5.89E-11	5.98E-11	1.83E-12	5.60E-02	3.30E-12	3.35E-12	7.02E-13	2.46E-11	4.00E-12	2.79E-11
4,4-Chlorobiphenyl	7.72E-13	7.83E-13	2.40E-14	2.26E-02	1.74E-14	1.77E-14	9.19E-15	3.22E-13	2.66E-14	3.39E-13
4-Chlorophenylmethylsulfone	3.92E-16	1.03E-14	5.86E-16	7.83E+00	3.07E-15	8.07E-14	2.24E-16	7.85E-15	3.30E-15	8.85E-14
4-Chlorophenylmethylsulfoxide	1.46E-15	3.83E-14	2.18E-15	6.58E+00	9.61E-15	2.52E-13	8.35E-16	2.92E-14	1.04E-14	2.82E-13
p,p-DDE	1.60E-12	8.05E-12	2.67E-13	1.95E-02	3.12E-14	1.57E-13	1.02E-13	3.58E-12	1.34E-13	3.74E-12
p,p-DDT	3.21E-16	1.61E-15	5.35E-17	7.96E-03	2.56E-18	1.28E-17	2.05E-17	7.17E-16	2.30E-17	7.30E-16
Dibenzofuran	1.01E-11	1.03E-11	3.15E-13	1.59E-01	1.61E-12	1.63E-12	1.21E-13	4.23E-12	1.73E-12	5.86E-12
Dieldrin	1.06E-15	1.08E-15	3.30E-17	9.86E-03	1.05E-17	1.06E-17	1.26E-17	4.42E-16	2.31E-17	4.52E-16
Diisopropyl Methylphosphonate	7.76E-15	1.36E-13	5.79E-15	3.86E+00	3.00E-14	5.24E-13	2.22E-15	7.76E-14	3.22E-14	6.02E-13
1,3-Dimethylbenzene	2.03E-11	2.06E-11	6.31E-13	5.42E-01	1.10E-11	1.12E-11	2.42E-13	8.46E-12	1.13E-11	1.96E-11
Dimethyl Methylphosphonate	3.06E-15	1.07E-13	1.38E-13	4.79E+02	1.47E-12	5.13E-11	5.29E-14	1.85E-12	1.52E-12	5.32E-11
Dimethylphosphate	1.22E-12	1.24E-12	3.79E-14				1.45E-14	5.08E-13	1.45E-14	5.08E-13
Dioxins/Furans (EPA TEFs)	7.64E-13	2.97E-12	9.68E-14	1.13E-02	8.61E-15	3.35E-14	3.71E-14	1.30E-12	4.57E-14	1.33E-12
Dithiane	1.86E-16	1.89E-16	5.79E-18	1.39E+01	2.59E-15	2.63E-15	2.22E-18	7.76E-17	2.59E-15	2.71E-15
Endrin	2.13E-16	9.73E-16	3.21E-17	8.81E-02	1.88E-17	8.58E-17	1.23E-17	4.30E-16	3.11E-17	5.16E-16
Hexachlorobenzene	4.33E-14	3.13E-13	1.08E-14	2.61E-02	1.13E-15	8.18E-15	4.13E-15	1.44E-13	5.26E-15	1.53E-13
Hexachlorocyclopentadiene	9.61E-15	9.75E-15	2.99E-16	2.48E-02	2.38E-16	2.42E-16	1.14E-16	4.00E-15	3.52E-16	4.24E-15
Isodrin	2.72E-15	2.76E-15	8.45E-17	6.52E-03	1.77E-17	1.80E-17	3.24E-17	1.13E-15	5.01E-17	1.15E-15
Malathion	4.15E-15	4.21E-15	1.29E-16	8.20E-01	3.40E-15	3.45E-15	4.94E-17	1.73E-15	3.45E-15	5.18E-15
Methanol	1.18E-10	1.20E-10	3.66E-12	1.16E+02	1.37E-08	1.39E-08	1.40E-12	4.91E-11	1.37E-08	1.40E-08
4-Nitrophenol	4.30E-14	4.36E-14	1.34E-15	7.98E-01	3.43E-14	3.48E-14	5.11E-16	1.79E-14	3.48E-14	5.27E-14
PAHs										
Acenaphthalene	5.08E-11	5.16E-11	1.58E-12	1.70E-01	8.62E-12	8.75E-12	6.05E-13	2.12E-11	9.23E-12	2.99E-11
Acenaphthene	5.08E-11	5.16E-11	1.58E-12	2.07E-01	1.05E-11	1.07E-11	6.05E-13	2.12E-11	1.11E-11	3.19E-11
Benzo(a)pyrene	1.79E-13	5.04E-12	3.15E-13	7.35E-03	1.31E-15	3.71E-14	1.21E-13	4.23E-12	1.22E-13	4.27E-12
Chrysene	2.24E-13	5.72E-12	3.15E-13	1.71E-02	3.82E-15	9.75E-14	1.21E-13	4.23E-12	1.25E-13	4.33E-12
Dibenzo(a,h)anthracene	2.43E-13	5.96E-12	3.15E-13	6.61E-03	1.61E-15	3.94E-14	1.21E-13	4.23E-12	1.22E-13	4.27E-12
Fluoranthene	6.56E-13	1.70E-11	9.48E-13	3.65E-02	2.39E-14	6.19E-13	3.63E-13	1.27E-11	3.87E-13	1.33E-11
Fluorene	1.01E-11	1.03E-11	3.15E-13	1.12E-01	1.14E-12	1.15E-12	1.21E-13	4.23E-12	1.26E-12	5.38E-12
Phenanthrene	3.10E-13	9.22E-12	6.31E-13	8.70E-02	2.70E-14	8.02E-13	2.42E-13	8.46E-12	2.69E-13	9.27E-12
Pyrene	1.50E-13	4.51E-12	3.15E-13	3.85E-02	5.79E-15	1.74E-13	1.21E-13	4.23E-12	1.27E-13	4.40E-12
Parathion	5.73E-16	5.81E-16	1.78E-17	2.40E-01	1.37E-16	1.39E-16	6.82E-18	2.39E-16	1.44E-16	3.78E-16
Pentachlorobenzene	1.55E-13	1.57E-13	4.82E-15	4.40E-02	6.82E-15	6.92E-15	1.85E-15	6.46E-14	8.67E-15	7.15E-14
Phenol	5.50E-10	5.58E-10	1.71E-11	5.54E+00	3.04E-09	3.09E-09	6.55E-12	2.29E-10	3.05E-09	3.32E-09
Quinoline	2.43E-14	2.46E-14	7.55E-16	2.59E+00	6.28E-14	6.37E-14	2.89E-16	1.01E-14	6.31E-14	7.38E-14
Supona	1.72E-15	1.75E-15	5.35E-17	6.11E-01	1.05E-15	1.07E-15	2.05E-17	7.17E-16	1.07E-15	1.78E-15
Tetrachlorobenzene	6.54E-14	6.63E-14	2.03E-15	1.14E-01	7.43E-15	7.53E-15	7.78E-16	2.72E-14	8.20E-15	3.48E-14

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Table 8C-3
(Continued)

Trichlorobenzene	3.44E-14	3.49E-14	1.07E-15	1.91E-01	6.59E-15	6.68E-15	4.10E-16	1.44E-14	7.00E-15	2.10E-14
Urea	7.45E-10	7.56E-10	2.32E-11	2.05E+03	1.53E-06	1.55E-06	8.87E-12	3.10E-10	1.53E-06	1.55E-06
Vapona	4.59E-15	4.65E-15	1.43E-16	6.00E+00	2.75E-14	2.79E-14	5.46E-17	1.91E-15	2.76E-14	2.98E-14
INORGANICS										
Antimony	4.73E-07	4.80E-07	1.47E-08	2.00E-03	9.46E-10	9.60E-10	5.63E-09	1.97E-07	6.58E-09	1.98E-07
Arsenic	2.68E-06	2.72E-06	8.32E-08	2.30E-01	6.16E-07	6.25E-07	3.19E-08	1.12E-06	6.48E-07	1.74E-06
Barium	6.56E-07	6.65E-07	2.04E-08	1.50E-02	9.84E-09	9.98E-09	7.81E-09	2.73E-07	1.76E-08	2.83E-07
Beryllium	2.74E-08	2.78E-08	8.51E-10	1.50E-03	4.11E-11	4.17E-11	3.26E-10	1.14E-08	3.67E-10	1.15E-08
Copper	2.51E-03	2.55E-03	7.80E-05	8.00E-02	2.01E-04	2.04E-04	2.99E-05	1.05E-03	2.31E-04	1.25E-03
Lead	8.40E-07	8.53E-07	2.61E-08	5.40E-02	4.54E-08	4.60E-08	1.00E-08	3.50E-07	5.54E-08	3.96E-07
Mercury	7.41E-07	7.52E-07	2.30E-08	2.20E-02	1.63E-08	1.65E-08	8.82E-09	3.09E-07	2.51E-08	3.25E-07
Selenium	6.87E-03	6.97E-03	2.13E-04	2.00E-01	1.37E-03	1.39E-03	8.18E-05	2.86E-03	1.46E-03	4.26E-03
Silver	7.12E-05	7.22E-05	2.21E-06	1.00E-01	7.12E-06	7.22E-06	8.47E-07	2.97E-05	7.97E-06	3.69E-05
Thallium	6.91E-06	7.01E-06	2.15E-07	4.00E-04	2.76E-09	2.80E-09	8.23E-08	2.88E-06	8.50E-08	2.88E-06

In calculating the average pollutant concentration from surface deposition, the factor of 2/70 accounts for the 2 years of pollutant deposition from the facility that would occur over a 70-year lifetime of an individual.

The surface deposition factor was calculated using the following formula (Holton, 1984):

$$\mathrm{SDF}\ (m^2 s/kg) = \frac{r\,(1-e^{-kt})}{Yk}$$

Where:

r = Interception fraction of the plants (unitless) (Baes et al., 1984).
k = Total rate constant for degradation processes (s^{-1}) (Baes et al., 1984)
t = Growing time (s) (Personal Communication).
Y = Plant yield (dry weight) (kg/m^2).

Pollutant concentrations were determined in terms of dry weight. The dry weight productivity factors (plant yields) that were used were based on information from Ron Jepson (Adams County Agricultural Extension Agency, Personal Communication, 1990). The plant yield used for hay (0.35 kg/m^2) was based on one crop of alfalfa hay. The plant yield for one crop of corn silage was assumed to be 1.80 kg/m^2.

An interception fraction for hay was calculated using the following formula (Baes et al., 1984):

$$\text{Interception fraction} = 1 - e^{(-2.88Y)}$$

Where:

Y = Productivity in dry weight (kg/m^2).

Using the preceding productivity factor, an interception fraction of 0.635 was obtained for hay. An average interception fraction of 0.44 was used for corn silage (Baes et al., 1984).

As in the case of vegetable produce, only weathering was considered as a source of pollutant loss. The derivation of the weathering loss constant, $5.78 \times 10^{-7} s^{-1}$, is discussed in Appendix 8B.

A growing time of 4.5 weeks (2.72E+06 seconds) was assumed for one crop of alfalfa hay, and 130 days (1.12E+07 seconds) for one crop of corn silage (Ron Jepson, Adams County Agricultural Extension Agency, Personal Communication, 1990).

For the Resident-A, Resident-B, and Farmer scenarios, it was conservatively assumed that all hay, corn, and grain fed to the cattle were grown at the farm location. As discussed in Subsection 8.1.1, for all scenarios, a farm is assumed to be located in the area of highest deposition and air concentration where cows were observed grazing.

8C.4 ESTIMATE OF POLLUTANT UPTAKE BY CATTLE

It was assumed that dairy cattle consume 22.45 kg (dry weight) of feed per day, and beef cattle consume 13 kg (dry weight) of feed per day (Dr. Tim Stanton, Colorado State University, Personal Communication, 1990). It was assumed that in the Rocky Mountain Arsenal area, a dairy cow's average diet consists of 55 percent grain, 17.5 percent corn silage, 17.5 percent hay, and 10 percent protein supplement. The average diet of beef cattle consists of 80 percent grain, 5 percent corn silage, 5 percent hay, and 10 percent protein supplement (derived from information provided by Dr. Tim Stanton, Colorado State University, Personal Communication, 1990). It was assumed that protein supplement is not exposed to pollutants in the area, and thus does not contribute to pollutants that cattle receive through their diet.

In addition, although some cattle in the area may graze, lactating dairy cattle and finishing stock do not graze, and thus, pasture grass and incidental soil ingested while grazing will not be evaluated.

The average pollutant concentration in the feed from all sources was calculated using the following general equation:

$$C_{feed} = [(C_{hay} \times DI_{hay}) + (C_{corn} \times DI_{corn}) + (C_{grain} \times DI_{grain})]/DI_{feed}$$

Where:

C_{feed} = Pollutant concentration in cattle feed, mg/kg.
C_{hay} = Pollutant concentration in hay, mg/kg.
DI_{hay} = Daily intake of hay, dry weight, kg/day.
C_{corn} = Pollutant concentration in corn silage, mg/kg.
DI_{corn} = Daily intake of corn silage, dry weight, kg/day.
C_{grain} = Pollutant concentration in grain, mg/kg.
DI_{grain} = Daily intake of grain, dry weight, kg/day.
DI_{feed} = $DI_{hay} + DI_{corn} + DI_{grain}$ kg/day.

The calculated average dairy cattle feed pollutant concentrations are presented for the Resident-A and Resident-B scenarios in Table 8C-4, and for the Farmer scenario in Table 8C-5. The maximum dairy cattle feed pollutant concentrations are presented in Tables 8C-6 and 8C-7. The calculated average beef cattle feed pollutant concentrations are presented in Tables 8C-8 and 8C-9, and the maximum beef cattle feed pollutant concentrations are presented in Tables 8C-10 and 8C-11.

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Table 8C-4

Average Pollutant Concentration in Milk for the Resident-A and Resident-B Scenarios

	AVERAGE CALCULATED CONC IN DIET (milk) mg/Kg	DIET UPTAKE MILK Unitless	TRANSFER COEFFICIENT MILK Day/Kg	AVERAGE CALCULATED CONC IN MILK mg/Kg	AVERAGE CALCULATED CONC IN MILK FAT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.69E-11		3.72E-09	2.24E-18		4.89E-22	2.82E-21
Aldrin	8.34E-17		2.04E-01	3.82E-16		8.33E-20	4.81E-19
Atrazine	2.81E-17		3.89E-06	2.46E-21		5.35E-25	3.09E-24
Benzaldehyde	5.15E-10		2.45E-07	2.84E-15		6.18E-19	3.57E-18
Benzofuran	2.04E-10		3.80E-06	1.74E-14		3.79E-18	2.19E-17
Benzoic Acid	1.48E-10		6.03E-07	2.01E-15		4.37E-19	2.53E-18
Benzonitrile	2.13E-13		2.95E-07	1.41E-18		3.08E-22	1.78E-21
Carbazole	4.36E-15		1.58E-05	1.55E-18		3.38E-22	1.95E-21
4-Chlorobiphenyl	3.81E-12		6.46E-04	5.53E-14		1.20E-17	6.96E-17
4,4-Chlorobiphenyl	2.68E-14		3.09E-03	1.86E-15		4.05E-19	2.34E-18
4-Chlorophenylmethylsulfone	3.04E-15		1.29E-07	8.78E-21		1.91E-24	1.10E-23
4-Chlorophenylmethylsulfoxide	9.66E-15		1.74E-07	3.77E-20		8.21E-24	4.74E-23
p,p-DDE	1.51E-13		3.98E-03	1.35E-14		2.95E-18	1.70E-17
p,p-DDT	2.70E-17		1.86E-02	1.13E-17		2.46E-21	1.42E-20
Dibenzofuran	1.59E-12		1.07E-04	3.84E-15		8.36E-19	4.83E-18
Dieldrin	2.46E-17		1.29E-02	7.13E-18		1.55E-21	8.96E-21
Diisopropyl Methylphosphonate	2.96E-14		4.37E-07	2.90E-19		6.33E-23	3.65E-22
1,3-Dimethylbenzene	1.02E-11		1.29E-05	2.95E-15		6.43E-19	3.71E-18
Dimethyl Methylphosphonate	1.38E-12		1.07E-10	3.33E-21		7.25E-25	4.18E-24
Dimethylphosphate	1.75E-14						
Dioxins/Furans (EPA TEFs)	5.24E-14	5.00E+00			2.62E-13	2.06E-18	1.35E-17
Dithiane	2.34E-15		4.79E-08	2.51E-21		5.47E-25	3.16E-24
Endrin	3.17E-17		2.95E-04	2.10E-19		4.58E-23	2.64E-22
Hexachlorobenzene	5.99E-15		2.40E-03	3.23E-16		7.03E-20	4.06E-19
Hexachlorocyclopentadiene	3.52E-16		2.63E-03	2.08E-17		4.53E-21	2.62E-20
Isodrin	5.50E-17		2.63E-02	3.25E-17		7.07E-21	4.08E-20
Malathion	3.12E-15		6.31E-06	4.42E-19		9.63E-23	5.56E-22
Methanol	1.23E-08		1.23E-09	3.41E-16		7.42E-20	4.29E-19
4-Nitrophenol	3.15E-14		6.61E-06	4.67E-18		1.02E-21	5.87E-21
PAHs							
Acenaphthalene	8.49E-12		9.55E-05	1.82E-14		3.97E-18	2.29E-17
Acenaphthene	1.02E-11		6.76E-05	1.55E-14		3.38E-18	1.95E-17
Benzo(a)pyrene	1.47E-13		2.14E-02	7.05E-14		1.54E-17	8.87E-17
Chrysene	1.49E-13		5.01E-03	1.68E-14		3.66E-18	2.11E-17
Dibenzo(a,h)anthracene	1.47E-13		2.57E-02	8.49E-14		1.85E-17	1.07E-16
Fluoranthene	4.60E-13		1.35E-03	1.39E-14		3.03E-18	1.75E-17
Fluorene	1.17E-12		1.95E-04	5.12E-15		1.12E-18	6.44E-18
Phenanthrene	3.16E-13		3.02E-04	2.14E-15		4.67E-19	2.70E-18
Pyrene	1.51E-13		1.23E-03	4.17E-15		9.08E-19	5.24E-18
Parathion	1.32E-16		5.25E-05	1.55E-19		3.39E-23	1.96E-22
Pentachlorobenzene	8.37E-15		9.77E-04	1.84E-16		4.00E-20	2.31E-19
Phenol	2.75E-09		2.34E-07	1.45E-14		3.15E-18	1.82E-17
Quinoline	5.68E-14		8.71E-07	1.11E-18		2.42E-22	1.40E-21
Supona	9.71E-16		1.05E-05	2.28E-19		4.97E-23	2.87E-22
Tetrachlorobenzene	7.62E-15		[illegible]-04	3.26E-17		7.10E-21	4.10E-20

Table 8C-4
(Continued)

Trichlorobenzene	6.42E-15	7.76E-05	1.12E-17	2.44E-21	1.41E-20
Urea	1.38E-06	8.71E-12	2.69E-16	5.87E-20	3.39E-19
Vapona	2.48E-14	2.04E-07	1.14E-19	2.48E-23	1.43E-22
INORGANICS					
Antimony	1.72E-08	1.00E-04	3.85E-11	8.40E-15	4.85E-14
Arsenic	2.45E-07	6.00E-03	3.30E-08	7.18E-12	4.15E-11
Barium	3.49E-08	3.50E-04	2.74E-10	5.98E-14	3.45E-13
Beryllium	4.71E-10	9.00E-07	9.52E-15	2.07E-18	1.20E-17
Copper	5.26E-04	1.50E-03	1.77E-05	3.86E-09	2.23E-08
Lead	4.27E-08	2.50E-04	2.40E-10	5.22E-14	3.02E-13
Mercury	1.25E-07	4.50E-04	1.26E-09	2.75E-13	1.59E-12
Selenium	6.74E-04	4.00E-03	6.05E-05	1.32E-08	7.61E-08
Silver	1.12E-05	2.00E-02	5.01E-06	1.09E-09	6.31E-09
Thallium	1.06E-07	2.00E-03	4.76E-09	1.04E-12	5.99E-12

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Table 8C-5

Average Pollutant Concentration in Milk for the Farmer Scenario

	AVERAGE CALCULATED CONC IN DIET (milk) mg/Kg	DIET UPTAKE MILK Unitless	TRANSFER COEFFICIENT MILK Day/Kg	AVERAGE CALCULATED CONC IN MILK mg/Kg	AVERAGE CALCULATED CONC IN MILK FAT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.69E-11		3.72E-09	2.24E-18		9.77E-21	5.64E-20
Aldrin	8.34E-17		2.04E-01	3.82E-16		1.67E-18	9.62E-18
Atrazine	2.81E-17		3.89E-06	2.46E-21		1.07E-23	6.18E-23
Benzaldehyde	5.15E-10		2.45E-07	2.84E-15		1.24E-17	7.14E-17
Benzofuran	2.04E-10		3.80E-06	1.74E-14		7.59E-17	4.38E-16
Benzoic Acid	1.48E-10		6.03E-07	2.01E-15		8.75E-18	5.05E-17
Benzonitrile	2.13E-13		2.95E-07	1.41E-18		6.16E-21	3.56E-20
Carbazole	4.36E-15		1.58E-05	1.55E-18		6.76E-21	3.90E-20
4-Chlorobiphenyl	3.81E-12		6.46E-04	5.53E-14		2.41E-16	1.39E-15
4,4-Chlorobiphenyl	2.68E-14		3.09E-03	1.86E-15		8.09E-18	4.67E-17
4-Chlorophenylmethylsulfone	3.04E-15		1.29E-07	8.78E-21		3.83E-23	2.21E-22
4-Chlorophenylmethylsulfoxide	9.66E-15		1.74E-07	3.77E-20		1.64E-22	9.48E-22
p,p-DDE	1.51E-13		3.98E-03	1.35E-14		5.90E-17	3.41E-16
p,p-DDT	2.70E-17		1.86E-02	1.13E-17		4.92E-20	2.84E-19
Dibenzofuran	1.59E-12		1.07E-04	3.84E-15		1.67E-17	9.65E-17
Dieldrin	2.46E-17		1.29E-02	7.13E-18		3.10E-20	1.79E-19
Diisopropyl Methylphosphonate	2.96E-14		4.37E-07	2.90E-19		1.27E-21	7.31E-21
1,3-Dimethylbenzene	1.02E-11		1.29E-05	2.95E-15		1.29E-17	7.42E-17
Dimethyl Methylphosphonate	1.38E-12		1.07E-10	3.33E-21		1.45E-23	8.37E-23
Dimethylphosphate	1.75E-14						
Dioxins/Furans (EPA TEFs)	5.24E-14	5.00E+00			2.62E-13	4.12E-17	2.71E-16
Dithiane	2.34E-15		4.79E-08	2.51E-21		1.09E-23	6.31E-23
Endrin	3.17E-17		2.95E-04	2.10E-19		9.15E-22	5.29E-21
Hexachlorobenzene	5.99E-15		2.40E-03	3.23E-16		1.41E-18	8.12E-18
Hexachlorocyclopentadiene	3.52E-16		2.63E-03	2.08E-17		9.06E-20	5.23E-19
Isodrin	5.50E-17		2.63E-02	3.25E-17		1.41E-19	8.17E-19
Malathion	3.12E-15		6.31E-06	4.42E-19		1.93E-21	1.11E-20
Methanol	1.23E-08		1.23E-09	3.41E-16		1.48E-18	8.57E-18
4-Nitrophenol	3.15E-14		6.61E-06	4.67E-18		2.03E-20	1.17E-19
PAHs							
Acenaphthalene	8.49E-12		9.55E-05	1.82E-14		7.93E-17	4.58E-16
Acenaphthene	1.02E-11		6.76E-05	1.55E-14		6.75E-17	3.90E-16
Benzo(a)pyrene	1.47E-13		2.14E-02	7.05E-14		3.07E-16	1.77E-15
Chrysene	1.49E-13		5.01E-03	1.68E-14		7.31E-17	4.22E-16
Dibenzo(a,h)anthracene	1.47E-13		2.57E-02	8.49E-14		3.70E-16	2.14E-15
Fluoranthene	4.60E-13		1.35E-03	1.39E-14		6.06E-17	3.50E-16
Fluorene	1.17E-12		1.95E-04	5.12E-15		2.23E-17	1.29E-16
Phenanthrene	3.16E-13		3.02E-04	2.14E-15		9.33E-18	5.39E-17
Pyrene	1.51E-13		1.23E-03	4.17E-15		1.82E-17	1.05E-16
Parathion	1.32E-16		5.25E-05	1.55E-19		6.77E-22	3.91E-21
Pentachlorobenzene	8.37E-15		9.77E-04	1.84E-16		8.00E-19	4.62E-18
Phenol	2.75E-09		2.34E-07	1.45E-14		6.30E-17	3.64E-16
Quinoline	5.68E-14		8.71E-07	1.11E-18		4.84E-21	2.80E-20
Supona	9.71E-16		1.05E-05	2.28E-19		9.95E-22	5.74E-21
Tetrachlorobenzene	7.62E-15		[illegible]04	3.26E-17		1.47E-19	8.20E-19

Table 8C-5
(Continued)

Trichlorobenzene	6.42E-15	7.76E-05	1.12E-17	4.88E-20	2.82E-19
Urea	1.38E-06	8.71E-12	2.69E-16	1.17E-18	6.77E-18
Vapona	2.48E-14	2.04E-07	1.14E-19	4.96E-22	2.86E-21
INORGANICS					
Antimony	1.72E-08	1.00E-04	3.85E-11	1.68E-13	9.70E-13
Arsenic	2.45E-07	6.00E-03	3.30E-08	1.44E-10	8.29E-10
Barium	3.49E-08	3.50E-04	2.74E-10	1.20E-12	6.90E-12
Beryllium	4.71E-10	9.00E-07	9.52E-15	4.15E-17	2.39E-16
Copper	5.26E-04	1.50E-03	1.77E-05	7.71E-08	4.45E-07
Lead	4.27E-08	2.50E-04	2.40E-10	1.04E-12	6.03E-12
Mercury	1.25E-07	4.50E-04	1.26E-09	5.49E-12	3.17E-11
Selenium	6.74E-04	4.00E-03	6.05E-05	2.64E-07	1.52E-06
Silver	1.12E-05	2.00E-02	5.01E-06	2.18E-08	1.26E-07
Thallium	1.06E-07	2.00E-03	4.76E-09	2.07E-11	1.20E-10

Table 8C-6

Maximum Pollutant Concentration in Milk for the Resident-A and Resident-B Scenarios

	MAXIMUM CALCULATED CONC IN DIET (milk) mg/Kg	DIET UPTAKE MILK Unitless	TRANSFER COEFFICIENT MILK Day/Kg	MAXIMUM CALCULATED CONC IN MILK mg/Kg	MAXIMUM CALCULATED CONC IN MILK FAT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.75E-11		3.72E-09	2.30E-18		5.00E-22	2.89E-21
Aldrin	2.61E-15		2.04E-01	1.19E-14		2.60E-18	1.50E-17
Atrazine	9.59E-16		3.89E-06	8.38E-20		1.82E-23	1.05E-22
Benzaldehyde	5.74E-10		2.45E-07	3.16E-15		6.89E-19	3.98E-18
Benzofuran	3.06E-10		3.80E-06	2.61E-14		5.69E-18	3.29E-17
Benzoic Acid	1.76E-10		6.03E-07	2.38E-15		5.17E-19	2.99E-18
Benzonitrile	2.40E-13		2.95E-07	1.59E-18		3.47E-22	2.00E-21
Carbazole	9.18E-15		1.58E-05	3.27E-18		7.12E-22	4.11E-21
4-Chlorobiphenyl	3.26E-11		6.46E-04	4.73E-13		1.03E-16	5.95E-16
4,4-Chlorobiphenyl	4.04E-13		3.09E-03	2.80E-14		6.10E-18	3.52E-17
4-Chlorophenylmethylsulfone	8.21E-14		1.29E-07	2.37E-19		5.17E-23	2.99E-22
4-Chlorophenylmethylsulfoxide	2.62E-13		1.74E-07	1.02E-18		2.23E-22	1.29E-21
p,p-DDE	4.46E-12		3.98E-03	3.98E-13		8.68E-17	5.01E-16
p,p-DDT	8.76E-16		1.86E-02	3.66E-16		7.98E-20	4.61E-19
Dibenzofuran	6.57E-12		1.07E-04	1.58E-14		3.44E-18	1.99E-17
Dieldrin	5.42E-16		1.29E-02	1.57E-16		3.42E-20	1.97E-19
Diisopropyl Methylphosphonate	5.65E-13		4.37E-07	5.54E-18		1.21E-21	6.97E-21
1,3-Dimethylbenzene	2.03E-11		1.29E-05	5.86E-15		1.28E-18	7.37E-18
Dimethyl Methylphosphonate	4.84E-11		1.07E-10	1.16E-19		2.54E-23	1.46E-22
Dimethylphosphate	6.12E-13						
Dioxins/Furans (EPA TEFs)	1.59E-12	5.00E+00			7.97E-12	6.26E-17	4.11E-16
Dithiane	2.46E-15		4.79E-08	2.64E-21		5.76E-25	3.33E-24
Endrin	5.96E-16		2.95E-04	3.95E-18		8.60E-22	4.96E-21
Hexachlorobenzene	1.82E-13		2.40E-03	9.78E-15		2.13E-18	1.23E-17
Hexachlorocyclopentadiene	5.05E-15		2.63E-03	2.98E-16		6.49E-20	3.75E-19
Isodrin	1.38E-15		2.63E-02	8.16E-16		1.78E-19	1.03E-18
Malathion	5.19E-15		6.31E-06	7.36E-19		1.60E-22	9.25E-22
Methanol	1.26E-08		1.23E-09	3.47E-16		7.57E-20	4.37E-19
4-Nitrophenol	5.29E-14		6.61E-06	7.85E-18		1.71E-21	9.87E-21
PAHs							
Acenaphthalene	3.34E-11		9.55E-05	7.17E-14		1.56E-17	9.01E-17
Acenaphthene	3.52E-11		6.76E-05	5.34E-14		1.16E-17	6.72E-17
Benzo(a)pyrene	5.13E-12		2.14E-02	2.46E-12		5.37E-16	3.10E-15
Chrysene	5.19E-12		5.01E-03	5.84E-13		1.27E-16	7.34E-16
Dibenzo(a,h)anthracene	5.14E-12		2.57E-02	2.96E-12		6.46E-16	3.73E-15
Fluoranthene	1.59E-11		1.35E-03	4.81E-13		1.05E-16	6.05E-16
Fluorene	6.14E-12		1.95E-04	2.69E-14		5.85E-18	3.38E-17
Phenanthrene	1.09E-11		3.02E-04	7.41E-14		1.61E-17	9.32E-17
Pyrene	5.26E-12		1.23E-03	1.45E-13		3.16E-17	1.83E-16
Parathion	4.13E-16		5.25E-05	4.87E-19		1.06E-22	6.13E-22
Pentachlorobenzene	8.41E-14		9.77E-04	1.85E-15		4.02E-19	2.32E-18
Phenol	3.06E-09		2.34E-07	1.61E-14		3.50E-18	2.02E-17
Quinoline	6.95E-14		8.71E-07	1.36E-18		2.96E-22	1.71E-21
Supona	1.82E-15		1.05E-05	4.29E-19		9.34E-23	5.40E-22
Tetrachlorobenzene	3.96E-14		1.91E-04	1.70E-16		3.69E-20	2.13E-19

Table 8C-6
(Continued)

Trichlorobenzene	2.33E-14	7.76E-05	4.07E-17	8.86E-21	5.11E-20
Urea	1.40E-06	8.71E-12	2.73E-16	5.95E-20	3.44E-19
Vapona	2.74E-14	2.04E-07	1.26E-19	2.74E-23	1.58E-22
INORGANICS					
Antimony	2.48E-07	1.00E-04	5.57E-10	1.21E-13	7.01E-13
Arsenic	1.55E-06	6.00E-03	2.09E-07	4.56E-11	2.63E-10
Barium	3.55E-07	3.50E-04	2.79E-09	6.08E-13	3.51E-12
Beryllium	1.38E-08	9.00E-07	2.80E-13	6.09E-17	3.52E-16
Copper	1.76E-03	1.50E-03	5.92E-05	1.29E-08	7.45E-08
Lead	4.53E-07	2.50E-04	2.54E-09	5.54E-13	3.20E-12
Mercury	4.88E-07	4.50E-04	4.93E-09	1.07E-12	6.20E-12
Selenium	4.04E-03	4.00E-03	3.62E-04	7.89E-08	4.56E-07
Silver	4.61E-05	2.00E-02	2.07E-05	4.51E-09	2.60E-08
Thallium	3.48E-06	2.00E-03	1.56E-07	3.40E-11	1.97E-10

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Table 8C-7

Maximum Pollutant Concentration in Milk for the Farmer Scenario

	MAXIMUM CALCULATED CONC IN DIET (milk) mg/Kg	DIET UPTAKE MILK Unitless	TRANSFER COEFFICIENT MILK Day/Kg	MAXIMUM CALCULATED CONC IN MILK mg/Kg	MAXIMUM CALCULATED CONC IN MILK FAT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.75E-11		3.72E-09	2.30E-18		1.00E-20	5.78E-20
Aldrin	2.61E-15		2.04E-01	1.19E-14		5.20E-17	3.01E-16
Atrazine	9.59E-16		3.89E-06	8.38E-20		3.65E-22	2.11E-21
Benzaldehyde	5.74E-10		2.45E-07	3.16E-15		1.38E-17	7.96E-17
Benzofuran	3.06E-10		3.80E-06	2.61E-14		1.14E-16	6.57E-16
Benzoic Acid	1.76E-10		6.03E-07	2.38E-15		1.03E-17	5.98E-17
Benzonitrile	2.40E-13		2.95E-07	1.59E-18		6.93E-21	4.00E-20
Carbazole	9.18E-15		1.58E-05	3.27E-18		1.42E-20	8.22E-20
4-Chlorobiphenyl	3.26E-11		6.46E-04	4.73E-13		2.06E-15	1.19E-14
4,4-Chlorobiphenyl	4.04E-13		3.09E-03	2.80E-14		1.22E-16	7.05E-16
4-Chlorophenylmethylsulfone	8.21E-14		1.29E-07	2.37E-19		1.03E-21	5.97E-21
4-Chlorophenylmethylsulfoxide	2.62E-13		1.74E-07	1.02E-18		4.46E-21	2.58E-20
p,p-DDE	4.46E-12		3.98E-03	3.98E-13		1.74E-15	1.00E-14
p,p-DDT	8.76E-16		1.86E-02	3.66E-16		1.60E-18	9.22E-18
Dibenzofuran	6.57E-12		1.07E-04	1.58E-14		6.89E-17	3.98E-16
Dieldrin	5.42E-16		1.29E-02	1.57E-16		6.84E-19	3.95E-18
Diisopropyl Methylphosphonate	5.65E-13		4.37E-07	5.54E-18		2.41E-20	1.39E-19
1,3-Dimethylbenzene	2.03E-11		1.29E-05	5.86E-15		2.55E-17	1.47E-16
Dimethyl Methylphosphonate	4.84E-11		1.07E-10	1.16E-19		5.07E-22	2.93E-21
Dimethylphosphate	6.12E-13						
Dioxins/Furans (EPA TEFs)	1.59E-12	5.00E+00			7.97E-12	1.25E-15	8.23E-15
Dithiane	2.46E-15		4.79E-08	2.64E-21		1.15E-23	6.65E-23
Endrin	5.96E-16		2.95E-04	3.95E-18		1.72E-20	9.93E-20
Hexachlorobenzene	1.82E-13		2.40E-03	9.78E-15		4.26E-17	2.46E-16
Hexachlorocyclopentadiene	5.05E-15		2.63E-03	2.98E-16		1.30E-18	7.50E-18
Isodrin	1.38E-15		2.63E-02	8.16E-16		3.56E-18	2.05E-17
Malathion	5.19E-15		6.31E-06	7.36E-19		3.20E-21	1.85E-20
Methanol	1.26E-08		1.23E-09	3.47E-16		1.51E-18	8.74E-18
4-Nitrophenol	5.29E-14		6.61E-06	7.85E-18		3.42E-20	1.97E-19
PAHs							
Acenaphthalene	3.34E-11		9.55E-05	7.17E-14		3.12E-16	1.80E-15
Acenaphthene	3.52E-11		6.76E-05	5.34E-14		2.33E-16	1.34E-15
Benzo(a)pyrene	5.13E-12		2.14E-02	2.46E-12		1.07E-14	6.20E-14
Chrysene	5.19E-12		5.01E-03	5.84E-13		2.54E-15	1.47E-14
Dibenzo(a,h)anthracene	5.14E-12		2.57E-02	2.96E-12		1.29E-14	7.46E-14
Fluoranthene	1.59E-11		1.35E-03	4.81E-13		2.10E-15	1.21E-14
Fluorene	6.14E-12		1.95E-04	2.69E-14		1.17E-16	6.76E-16
Phenanthrene	1.09E-11		3.02E-04	7.41E-14		3.23E-16	1.86E-15
Pyrene	5.26E-12		1.23E-03	1.45E-13		6.33E-16	3.65E-15
Parathion	4.13E-16		5.25E-05	4.87E-19		2.12E-21	1.23E-20
Pentachlorobenzene	8.41E-14		9.77E-04	1.85E-15		8.04E-18	4.64E-17
Phenol	3.06E-09		2.34E-07	1.61E-14		7.01E-17	4.05E-16
Quinoline	6.95E-14		8.71E-07	1.36E-18		5.92E-21	3.42E-20
Supona	1.82E-15		1.05E-05	4.29E-19		1.87E-21	1.08E-20
Tetrachlorobenzene	3.96E-14		[illegible]91E-04	1.70E-16		7.39E-19	4.27E-18

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Table 8C-7
(Continued)

Trichlorobenzene	2.33E-14	7.76E-05	4.07E-17	1.77E-19	1.02E-18
Urea	1.40E-06	8.71E-12	2.73E-16	1.19E-18	6.87E-18
Vapona	2.74E-14	2.04E-07	1.26E-19	5.48E-22	3.16E-21
INORGANICS					
Antimony	2.48E-07	1.00E-04	5.57E-10	2.43E-12	1.40E-11
Arsenic	1.55E-06	6.00E-03	2.09E-07	9.12E-10	5.27E-09
Barium	3.55E-07	3.50E-04	2.79E-09	1.22E-11	7.03E-11
Beryllium	1.38E-08	9.00E-07	2.80E-13	1.22E-15	7.04E-15
Copper	1.76E-03	1.50E-03	5.92E-05	2.58E-07	1.49E-06
Lead	4.53E-07	2.50E-04	2.54E-09	1.11E-11	6.40E-11
Mercury	4.88E-07	4.50E-04	4.93E-09	2.15E-11	1.24E-10
Selenium	4.04E-03	4.00E-03	3.62E-04	1.58E-06	9.12E-06
Silver	4.61E-05	2.00E-02	2.07E-05	9.01E-08	5.20E-07
Thallium	3.48E-06	2.00E-03	1.56E-07	6.81E-10	3.93E-09

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Table 8C-8

Average Pollutant Concentration in Beef for the Resident-A and Resident-B Scenarios

	AVERAGE CALCULATED CONC IN DIET (beef) mg/Kg	DIET UPTAKE BEEF Unitless	TRANSFER COEFFICIENT BEEF Day/Kg	AVERAGE CALCULATED CONC IN BEEF mg/Kg	AVERAGE CALCULATED CONC IN BEEFFAT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.69E-11		1.15E-08	4.00E-18		1.92E-22	4.78E-22
Aldrin	3.04E-17		6.31E-01	2.49E-16		1.19E-20	2.97E-20
Atrazine	1.64E-17		1.20E-05	2.55E-21		1.22E-25	3.04E-25
Benzaldehyde	5.14E-10		7.59E-07	5.06E-15		2.42E-19	6.03E-19
Benzofuran	2.02E-10		1.17E-05	3.08E-14		1.47E-18	3.67E-18
Benzoic Acid	1.48E-10		1.86E-06	3.57E-15		1.71E-19	4.26E-19
Benzonitrile	2.13E-13		9.12E-07	2.52E-18		1.20E-22	3.00E-22
Carbazole	4.26E-15		4.90E-05	2.71E-18		1.29E-22	3.23E-22
4-Chlorobiphenyl	3.21E-12		2.00E-03	8.31E-14		3.98E-18	9.92E-18
4,4-Chlorobiphenyl	1.88E-14		9.55E-03	2.33E-15		1.12E-19	2.79E-19
4-Chlorophenylmethylsulfone	2.84E-15		3.98E-07	1.47E-20		7.02E-25	1.75E-24
4-Chlorophenylmethylsulfoxide	8.94E-15		5.37E-07	6.23E-20		2.98E-24	7.43E-24
p,p-DDE	6.34E-14		1.23E-02	1.01E-14		4.84E-19	1.21E-18
p,p-DDT	9.36E-18		5.75E-02	6.98E-18		3.34E-22	8.34E-22
Dibenzofuran	1.49E-12		3.31E-04	6.40E-15		3.06E-19	7.64E-19
Dieldrin	1.38E-17		3.98E-02	7.11E-18		3.40E-22	8.48E-22
Diisopropyl Methylphosphonate	2.77E-14		1.35E-06	4.85E-19		2.32E-23	5.79E-23
1,3-Dimethylbenzene	9.99E-12		3.98E-05	5.16E-15		2.47E-19	6.16E-19
Dimethyl Methylphosphonate	1.34E-12		3.31E-10	5.74E-21		2.75E-25	6.85E-25
Dimethylphosphate	5.00E-15						
Dioxins/Furans (EPA TEFs)	2.05E-14	5.00E+00			1.03E-13	1.10E-18	2.98E-18
Dithiane	2.33E-15		1.48E-07	4.48E-21		2.14E-25	5.34E-25
Endrin	2.11E-17		9.12E-04	2.50E-19		1.20E-23	2.98E-23
Hexachlorobenzene	2.44E-15		7.41E-03	2.35E-16		1.12E-20	2.80E-20
Hexachlorocyclopentadiene	2.54E-16		8.13E-03	2.67E-17		1.28E-21	3.19E-21
Isodrin	2.71E-17		8.13E-02	2.86E-17		1.37E-21	3.41E-21
Malathion	3.08E-15		1.95E-05	7.79E-19		3.73E-23	9.30E-23
Methanol	1.23E-08		3.80E-09	6.08E-16		2.91E-20	7.26E-20
4-Nitrophenol	3.10E-14		2.04E-05	8.22E-18		3.93E-22	9.81E-22
PAHs							
Acenaphthalene	7.97E-12		2.95E-04	3.05E-14		1.46E-18	3.64E-18
Acenaphthene	9.69E-12		2.09E-04	2.63E-14		1.26E-18	3.13E-18
Benzo(a)pyrene	4.28E-14		6.61E-02	3.67E-14		1.76E-18	4.38E-18
Chrysene	4.51E-14		1.55E-02	9.05E-15		4.33E-19	1.08E-18
Dibenzo(a,h)anthracene	4.31E-14		7.94E-02	4.44E-14		2.12E-18	5.30E-18
Fluoranthene	1.47E-13		4.17E-03	7.93E-15		3.80E-19	9.47E-19
Fluorene	1.07E-12		6.03E-04	8.33E-15		3.98E-19	9.94E-19
Phenanthrene	1.08E-13		9.33E-04	1.30E-15		6.24E-20	1.56E-19
Pyrene	4.68E-14		3.80E-03	2.31E-15		1.11E-19	2.76E-19
Parathion	1.26E-16		1.62E-04	2.65E-19		1.27E-23	3.16E-23
Pentachlorobenzene	6.78E-15		3.02E-03	2.65E-16		1.27E-20	3.17E-20
Phenol	2.74E-09		7.24E-07	2.58E-14		1.23E-18	3.07E-18
Quinoline	5.66E-14		2.69E-06	1.98E-18		9.46E-23	2.36E-22
Supona	9.53E-16		3.24E-05	4.00E-19		1.91E-23	4.78E-23
Tetrachlorobenzene	6.95E-15		[illegible]9E-04	5.31E-17		2.54E-21	6.34E-21

Table 8C-8
(Continued)

Trichlorobenzene	6.07E-15	2.40E-04	1.89E-17	9.04E-22	2.25E-21
Urea	1.38E-06	2.69E-11	4.81E-16	2.30E-20	5.74E-20
Vapona	2.48E-14	6.31E-07	2.03E-19	9.70E-24	2.42E-23
INORGANICS					
Antimony	1.40E-08	1.00E-03	1.82E-10	8.71E-15	2.17E-14
Arsenic	7.56E-08	2.00E-03	1.96E-09	9.39E-14	2.34E-13
Barium	1.63E-08	1.50E-04	3.17E-11	1.52E-15	3.78E-15
Beryllium	1.61E-10	1.00E-03	2.09E-12	9.99E-17	2.49E-16
Copper	4.25E-04	1.00E-02	5.51E-05	2.64E-09	6.57E-09
Lead	2.55E-08	3.00E-04	9.92E-11	4.75E-15	1.18E-14
Mercury	1.31E-07	2.50E-01	4.24E-07	2.03E-11	5.07E-11
Selenium	3.03E-04	1.50E-02	5.89E-05	2.82E-09	7.03E-09
Silver	7.77E-06	3.00E-03	3.02E-07	1.45E-11	3.61E-11
Thallium	3.21E-08	4.00E-02	1.66E-08	7.97E-13	1.99E-12

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Table 8C-9

Average Pollutant Concentration in Beef for the Farmer Scenario

	AVERAGE CALCULATED CONC IN DIET (beef) mg/Kg	DIET UPTAKE BEEF Unitless	TRANSFER COEFFICIENT BEEF Day/Kg	AVERAGE CALCULATED CONC IN BEEF mg/Kg	AVERAGE CALCULATED CONC IN BEEFFAT mg/Kg	ADULT AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	CHILD AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.69E-11		1.15E-08	4.00E-18		3.83E-21	9.56E-21
Aldrin	3.04E-17		6.31E-01	2.49E-16		2.38E-19	5.95E-19
Atrazine	1.64E-17		1.20E-05	2.55E-21		2.44E-24	6.09E-24
Benzaldehyde	5.14E-10		7.59E-07	5.06E-15		4.84E-18	1.21E-17
Benzofuran	2.02E-10		1.17E-05	3.08E-14		2.95E-17	7.35E-17
Benzoic Acid	1.48E-10		1.86E-06	3.57E-15		3.42E-18	8.53E-18
Benzonitrile	2.13E-13		9.12E-07	2.52E-18		2.41E-21	6.01E-21
Carbazole	4.26E-15		4.90E-05	2.71E-18		2.59E-21	6.46E-21
4-Chlorobiphenyl	3.21E-12		2.00E-03	8.31E-14		7.95E-17	1.98E-16
4,4-Chlorobiphenyl	1.88E-14		9.55E-03	2.33E-15		2.23E-18	5.57E-18
4-Chlorophenylmethylsulfone	2.84E-15		3.98E-07	1.47E-20		1.40E-23	3.50E-23
4-Chlorophenylmethylsulfoxide	8.94E-15		5.37E-07	6.23E-20		5.96E-23	1.49E-22
p,p-DDE	6.34E-14		1.23E-02	1.01E-14		9.68E-18	2.41E-17
p,p-DDT	9.36E-18		5.75E-02	6.98E-18		6.69E-21	1.67E-20
Dibenzofuran	1.49E-12		3.31E-04	6.40E-15		6.13E-18	1.53E-17
Dieldrin	1.38E-17		3.98E-02	7.11E-18		6.80E-21	1.70E-20
Diisopropyl Methylphosphonate	2.77E-14		1.35E-06	4.85E-19		4.64E-22	1.16E-21
1,3-Dimethylbenzene	9.99E-12		3.98E-05	5.16E-15		4.94E-18	1.23E-17
Dimethyl Methylphosphonate	1.34E-12		3.31E-10	5.74E-21		5.50E-24	1.37E-23
Dimethylphosphate	5.00E-15						
Dioxins/Furans (EPA TEFs)	2.05E-14	5.00E+00			1.03E-13	2.20E-17	5.96E-17
Dithiane	2.33E-15		1.48E-07	4.48E-21		4.29E-24	1.07E-23
Endrin	2.11E-17		9.12E-04	2.50E-19		2.39E-22	5.97E-22
Hexachlorobenzene	2.44E-15		7.41E-03	2.35E-16		2.25E-19	5.60E-19
Hexachlorocyclopentadiene	2.54E-16		8.13E-03	2.67E-17		2.56E-20	6.39E-20
Isodrin	2.71E-17		8.13E-02	2.86E-17		2.73E-20	6.82E-20
Malathion	3.08E-15		1.95E-05	7.79E-19		7.45E-22	1.86E-21
Methanol	1.23E-08		3.80E-09	6.08E-16		5.82E-19	1.45E-18
4-Nitrophenol	3.10E-14		2.04E-05	8.22E-18		7.87E-21	1.96E-20
PAHs							
Acenaphthalene	7.97E-12		2.95E-04	3.05E-14		2.92E-17	7.28E-17
Acenaphthene	9.69E-12		2.09E-04	2.63E-14		2.51E-17	6.27E-17
Benzo(a)pyrene	4.28E-14		6.61E-02	3.67E-14		3.51E-17	8.76E-17
Chrysene	4.51E-14		1.55E-02	9.05E-15		8.67E-18	2.16E-17
Dibenzo(a,h)anthracene	4.31E-14		7.94E-02	4.44E-14		4.25E-17	1.06E-16
Fluoranthene	1.47E-13		4.17E-03	7.93E-15		7.59E-18	1.89E-17
Fluorene	1.07E-12		6.03E-04	8.33E-15		7.97E-18	1.99E-17
Phenanthrene	1.08E-13		9.33E-04	1.30E-15		1.25E-18	3.11E-18
Pyrene	4.68E-14		3.80E-03	2.31E-15		2.21E-18	5.51E-18
Parathion	1.26E-16		1.62E-04	2.65E-19		2.54E-22	6.33E-22
Pentachlorobenzene	6.78E-15		3.02E-03	2.65E-16		2.54E-19	6.34E-19
Phenol	2.74E-09		7.24E-07	2.58E-14		2.47E-17	6.15E-17
Quinoline	5.66E-14		2.69E-06	1.98E-18		1.89E-21	4.72E-21
Supona	9.53E-16		3.24E-05	4.00E-19		3.83E-22	9.55E-22
Tetrachlorobenzene	6.95E-15		5.89E-04	5.31E-17		5.08E-20	1.27E-19

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Table 8C-9
(Continued)

Trichlorobenzene	6.07E-15	2.40E-04	1.89E-17	1.81E-20	4.51E-20
Urea	1.38E-06	2.69E-11	4.81E-16	4.60E-19	1.15E-18
Vapona	2.48E-14	6.31E-07	2.03E-19	1.94E-22	4.84E-22
INORGANICS					
Antimony	1.40E-08	1.00E-03	1.82E-10	1.74E-13	4.34E-13
Arsenic	7.56E-08	2.00E-03	1.96E-09	1.88E-12	4.68E-12
Barium	1.63E-08	1.50E-04	3.17E-11	3.03E-14	7.57E-14
Beryllium	1.61E-10	1.00E-03	2.09E-12	2.00E-15	4.98E-15
Copper	4.25E-04	1.00E-02	5.51E-05	5.27E-08	1.31E-07
Lead	2.55E-08	3.00E-04	9.92E-11	9.49E-14	2.37E-13
Mercury	1.31E-07	2.50E-01	4.24E-07	4.06E-10	1.01E-09
Selenium	3.03E-04	1.50E-02	5.89E-05	5.64E-08	1.41E-07
Silver	7.77E-06	3.00E-03	3.02E-07	2.89E-10	7.21E-10
Thallium	3.21E-08	4.00E-02	1.66E-08	1.59E-11	3.97E-11

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Table 8C-10

Maximum Pollutant Concentration in Beef for the Resident-A and Resident-B Scenarios

	MAXIMUM CALCULATED CONC IN DIET (beef) mg/Kg	DIET UPTAKE BEEF Unitless	TRANSFER COEFFICIENT BEEF Day/Kg	MAXIMUM CALCULATED CONC IN BEEF mg/Kg	MAXIMUM CALCULATED CONC IN BEEFFAT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.73E-11		1.15E-08	4.07E-18		1.95E-22	4.86E-22
Aldrin	7.51E-16		6.31E-01	6.15E-15		2.94E-19	7.34E-19
Atrazine	5.47E-16		1.20E-05	8.53E-20		4.08E-24	1.02E-23
Benzaldehyde	5.36E-10		7.59E-07	5.27E-15		2.52E-19	6.29E-19
Benzofuran	2.33E-10		1.17E-05	3.55E-14		1.70E-18	4.24E-18
Benzoic Acid	1.57E-10		1.86E-06	3.80E-15		1.82E-19	4.53E-19
Benzonitrile	2.23E-13		9.12E-07	2.63E-18		1.26E-22	3.14E-22
Carbazole	5.68E-15		4.90E-05	3.61E-18		1.73E-22	4.31E-22
4-Chlorobiphenyl	1.15E-11		2.00E-03	2.97E-13		1.42E-17	3.54E-17
4,4-Chlorobiphenyl	1.27E-13		9.55E-03	1.57E-14		7.51E-19	1.87E-18
4-Chlorophenylmethylsulfone	7.53E-14		3.98E-07	3.89E-19		1.86E-23	4.64E-23
4-Chlorophenylmethylsulfoxide	2.37E-13		5.37E-07	1.65E-18		7.91E-23	1.97E-22
p,p-DDE	1.37E-12		1.23E-02	2.19E-13		1.05E-17	2.62E-17
p,p-DDT	2.59E-16		5.75E-02	1.93E-16		9.24E-21	2.30E-20
Dibenzofuran	2.93E-12		3.31E-04	1.26E-14		6.02E-19	1.50E-18
Dieldrin	1.62E-16		3.98E-02	8.35E-17		4.00E-21	9.97E-21
Diisopropyl Methylphosphonate	4.98E-13		1.35E-06	8.72E-18		4.17E-22	1.04E-21
1,3-Dimethylbenzene	1.30E-11		3.98E-05	6.70E-15		3.20E-19	7.99E-19
Dimethyl Methylphosphonate	4.68E-11		3.31E-10	2.01E-19		9.62E-24	2.40E-23
Dimethylphosphate	1.75E-13						
Dioxins/Furans (EPA TEFs)	4.77E-13	5.00E+00			2.39E-12	2.56E-17	6.93E-17
Dithiane	2.39E-15		1.48E-07	4.59E-21		2.20E-25	5.48E-25
Endrin	2.25E-16		9.12E-04	2.67E-18		1.28E-22	3.18E-22
Hexachlorobenzene	5.71E-14		7.41E-03	5.49E-15		2.63E-19	6.55E-19
Hexachlorocyclopentadiene	1.60E-15		8.13E-03	1.68E-16		8.06E-21	2.01E-20
Isodrin	4.07E-16		8.13E-02	4.29E-16		2.05E-20	5.12E-20
Malathion	3.70E-15		1.95E-05	9.36E-19		4.48E-23	1.12E-22
Methanol	1.25E-08		3.80E-09	6.18E-16		2.96E-20	7.38E-20
4-Nitrophenol	3.75E-14		2.04E-05	9.92E-18		4.75E-22	1.18E-21
PAHs							
Acenaphthalene	1.52E-11		2.95E-04	5.81E-14		2.78E-18	6.93E-18
Acenaphthene	1.69E-11		2.09E-04	4.58E-14		2.19E-18	5.47E-18
Benzo(a)pyrene	1.49E-12		6.61E-02	1.28E-12		6.11E-17	1.52E-16
Chrysene	1.54E-12		1.55E-02	3.10E-13		1.49E-17	3.70E-17
Dibenzo(a,h)anthracene	1.49E-12		7.94E-02	1.54E-12		7.36E-17	1.84E-16
Fluoranthene	4.94E-12		4.17E-03	2.67E-13		1.28E-17	3.19E-17
Fluorene	2.50E-12		6.03E-04	1.95E-14		9.33E-19	2.33E-18
Phenanthrene	3.64E-12		9.33E-04	4.40E-14		2.11E-18	5.26E-18
Pyrene	1.61E-12		3.80E-03	7.96E-14		3.81E-18	9.50E-18
Parathion	2.08E-16		1.62E-04	4.37E-19		2.09E-23	5.22E-23
Pentachlorobenzene	2.85E-14		3.02E-03	1.12E-15		5.34E-20	1.33E-19
Phenol	2.86E-09		7.24E-07	2.69E-14		1.29E-18	3.21E-18
Quinoline	6.08E-14		2.69E-06	2.12E-18		1.02E-22	2.53E-22
Supona	1.21E-15		3.24E-05	5.07E-19		2.42E-23	6.05E-23
Tetrachlorobenzene	1.62E-14		5.89E-04	1.23E-16		5.91E-21	1.47E-20

Table 8C-10
(Continued)

Trichlorobenzene	1.10E-14	2.40E-04	3.41E-17	1.63E-21	4.07E-21
Urea	1.40E-06	2.69E-11	4.88E-16	2.33E-20	5.82E-20
Vapona	2.58E-14	6.31E-07	2.11E-19	1.01E-23	2.52E-23
INORGANICS					
Antimony	8.02E-08	1.00E-03	1.04E-09	4.98E-14	1.24E-13
Arsenic	4.50E-07	2.00E-03	1.17E-08	5.59E-13	1.39E-12
Barium	1.08E-07	1.50E-04	2.10E-10	1.01E-14	2.51E-14
Beryllium	3.98E-09	1.00E-03	5.17E-11	2.47E-15	6.16E-15
Copper	7.81E-04	1.00E-02	1.01E-04	4.85E-09	1.21E-08
Lead	1.43E-07	3.00E-04	5.57E-10	2.66E-14	6.64E-14
Mercury	2.36E-07	2.50E-01	7.66E-07	3.66E-11	9.14E-11
Selenium	1.27E-03	1.50E-02	2.46E-04	1.18E-08	2.94E-08
Silver	1.78E-05	3.00E-03	6.93E-07	3.32E-11	8.27E-11
Thallium	9.96E-07	4.00E-02	5.17E-07	2.47E-11	6.17E-11

Table 8C-11

Maximum Pollutant Concentration in Beef for the Farmer Scenario

	MAXIMUM CALCULATED CONC IN DIET (beef) mg/Kg	DIET UPTAKE BEEF Unitless	TRANSFER COEFFICIENT BEEF Day/Kg	MAXIMUM CALCULATED CONC IN BEEF mg/Kg	MAXIMUM CALCULATED CONC IN BEEFFAT mg/Kg	ADULT MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day	CHILD MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS							
Acetonitrile	2.73E-11		1.15E-08	4.07E-18		3.90E-21	9.72E-21
Aldrin	7.51E-16		6.31E-01	6.15E-15		5.88E-18	1.47E-17
Atrazine	5.47E-16		1.20E-05	8.53E-20		8.17E-23	2.04E-22
Benzaldehyde	5.36E-10		7.59E-07	5.27E-15		5.05E-18	1.26E-17
Benzofuran	2.33E-10		1.17E-05	3.55E-14		3.40E-17	8.48E-17
Benzoic Acid	1.57E-10		1.86E-06	3.80E-15		3.63E-18	9.06E-18
Benzonitrile	2.23E-13		9.12E-07	2.63E-18		2.52E-21	6.29E-21
Carbazole	5.68E-15		4.90E-05	3.61E-18		3.45E-21	8.61E-21
4-Chlorobiphenyl	1.15E-11		2.00E-03	2.97E-13		2.84E-16	7.09E-16
4,4-Chlorobiphenyl	1.27E-13		9.55E-03	1.57E-14		1.50E-17	3.75E-17
4-Chlorophenylmethylsulfone	7.53E-14		3.98E-07	3.89E-19		3.72E-22	9.28E-22
4-Chlorophenylmethylsulfoxide	2.37E-13		5.37E-07	1.65E-18		1.58E-21	3.94E-21
p,p-DDE	1.37E-12		1.23E-02	2.19E-13		2.10E-16	5.24E-16
p,p-DDT	2.59E-16		5.75E-02	1.93E-16		1.85E-19	4.61E-19
Dibenzofuran	2.93E-12		3.31E-04	1.26E-14		1.20E-17	3.00E-17
Dieldrin	1.62E-16		3.98E-02	8.35E-17		8.00E-20	1.99E-19
Diisopropyl Methylphosphonate	4.98E-13		1.35E-06	8.72E-18		8.35E-21	2.08E-20
1,3-Dimethylbenzene	1.30E-11		3.98E-05	6.70E-15		6.41E-18	1.60E-17
Dimethyl Methylphosphonate	4.68E-11		3.31E-10	2.01E-19		1.92E-22	4.80E-22
Dimethylphosphate	1.75E-13						
Dioxins/Furans (EPA TEFs)	4.77E-13	5.00E+00			2.39E-12	5.11E-16	1.39E-15
Dithiane	2.39E-15		1.48E-07	4.59E-21		4.40E-24	1.10E-23
Endrin	2.25E-16		9.12E-04	2.67E-18		2.55E-21	6.36E-21
Hexachlorobenzene	5.71E-14		7.41E-03	5.49E-15		5.26E-18	1.31E-17
Hexachlorocyclopentadiene	1.60E-15		8.13E-03	1.68E-16		1.61E-19	4.02E-19
Isodrin	4.07E-16		8.13E-02	4.29E-16		4.10E-19	1.02E-18
Malathion	3.70E-15		1.95E-05	9.36E-19		8.96E-22	2.24E-21
Methanol	1.25E-08		3.80E-09	6.18E-16		5.91E-19	1.48E-18
4-Nitrophenol	3.75E-14		2.04E-05	9.92E-18		9.50E-21	2.37E-20
PAHs							
Acenaphthalene	1.52E-11		2.95E-04	5.81E-14		5.56E-17	1.39E-16
Acenaphthene	1.69E-11		2.09E-04	4.58E-14		4.39E-17	1.09E-16
Benzo(a)pyrene	1.49E-12		6.61E-02	1.28E-12		1.22E-15	3.05E-15
Chrysene	1.54E-12		1.55E-02	3.10E-13		2.97E-16	7.41E-16
Dibenzo(a,h)anthracene	1.49E-12		7.94E-02	1.54E-12		1.47E-15	3.67E-15
Fluoranthene	4.94E-12		4.17E-03	2.67E-13		2.56E-16	6.37E-16
Fluorene	2.50E-12		6.03E-04	1.95E-14		1.87E-17	4.66E-17
Phenanthrene	3.64E-12		9.33E-04	4.40E-14		4.22E-17	1.05E-16
Pyrene	1.61E-12		3.80E-03	7.96E-14		7.61E-17	1.90E-16
Parathion	2.08E-16		1.62E-04	4.37E-19		4.18E-22	1.04E-21
Pentachlorobenzene	2.85E-14		3.02E-03	1.12E-15		1.07E-18	2.66E-18
Phenol	2.86E-09		7.24E-07	2.69E-14		2.57E-17	6.41E-17
Quinoline	6.08E-14		2.69E-06	2.12E-18		2.03E-21	5.07E-21
Supona	1.21E-15		3.24E-05	5.07E-19		4.85E-22	1.21E-21
Tetrachlorobenzene	1.62E-14		5.89E-04	1.23E-16		1.18E-19	2.95E-19

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Table 8C-11
(Continued)

Trichlorobenzene	1.10E-14	2.40E-04	3.41E-17	3.26E-20	8.14E-20
Urea	1.40E-06	2.69E-11	4.88E-16	4.67E-19	1.16E-18
Vapona	2.58E-14	6.31E-07	2.11E-19	2.02E-22	5.03E-22
INORGANICS					
Antimony	8.02E-08	1.00E-03	1.04E-09	9.96E-13	2.48E-12
Arsenic	4.50E-07	2.00E-03	1.17E-08	1.12E-11	2.79E-11
Barium	1.08E-07	1.50E-04	2.10E-10	2.01E-13	5.01E-13
Beryllium	3.98E-09	1.00E-03	5.17E-11	4.94E-14	1.23E-13
Copper	7.81E-04	1.00E-02	1.01E-04	9.69E-08	2.42E-07
Lead	1.43E-07	3.00E-04	5.57E-10	5.33E-13	1.33E-12
Mercury	2.36E-07	2.50E-01	7.66E-07	7.33E-10	1.83E-09
Selenium	1.27E-03	1.50E-02	2.46E-04	2.36E-07	5.87E-07
Silver	1.78E-05	3.00E-03	6.93E-07	6.63E-10	1.65E-09
Thallium	9.96E-07	4.00E-02	5.17E-07	4.95E-10	1.23E-09

8C.5 CALCULATION OF THE POLLUTANT CONCENTRATION IN FARM PRODUCTS

The pollutant concentration in beef and dairy products resulting from ingestion of hay, grain, and corn silage by beef and dairy cattle is calculated as follows:

$$C_{product} = C_{diet} \times DUF$$

Where:

$C_{product}$ = Pollutant concentration in farm product (milk, beef) (mg/kg).

C_{diet} = Average pollutant concentration in total animal diet (mg/kg).

DUF = Diet uptake factor, pollutant concentration ratio between farm product and feed. Specific to pollutant and product (unitless).

8C.5.1 Dioxins

The DUFs for dioxin were taken from current research that has investigated the feed/product pollutant relationship. Fries and Paustenbach (1990) reported a steady-state transfer ratio for dioxin of 5-to-1 between milk fat and dairy feed (dry weight), and between beef fat and cattle feed (dry weight). These DUFs were used to calculate dioxin concentrations in milk fat and beef fat.

8C.5.2 Other Pollutants

Concentrations for inorganics as well as all other organics were calculated in milk and beef. The DUFs for these pollutants were calculated by multiplying transfer coefficients (day/kg) by the daily feed intake, 22.45 kg/day (dairy cattle), and 13 kg/day (beef

cattle). Transfer coefficients (TC) for the organics were derived using equations developed by Travis et al. (1988):

$$TC_{milk} = 10^{(-8.09 + \text{Log}\ K_{ow})}$$

$$TC_{beef} = 10^{(-7.6 + \text{Log}\ K_{ow})}$$

The log K_{OW} can be found in Appendix 8B, Table 8B-1.

Transfer coefficients for the inorganics were identified by Baes et al. (1984) for dairy and beef cattle.

The calculated pollutant concentrations in milk and milk fat as well as daily intakes are summarized in Tables 8C-4 and 8C-5 (average levels) and Tables 8C-6 and 8C-7 (maximum levels). Beef and beef fat pollutant concentrations and daily intakes are summarized in Tables 8C-8 and 8C-9 (average levels) and Tables 8C-10 and 8C-11 (maximum levels).

APPENDIX 8C

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APPENDIX 8D

CALCULATION OF THE ESTIMATED DAILY INTAKE FOR THE SOIL/DUST INGESTION ROUTE OF EXPOSURE

Table 8D-1

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Adult, Resident-A Scenario

	AVERAGE		MAXIMUM	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	1.14E-12	1.63E-18	1.15E-12	1.65E-18
Aldrin	1.21E-14	1.72E-20	1.22E-14	1.75E-20
Atrazine	2.78E-17	3.98E-23	9.14E-16	1.31E-21
Benzaldehyde	2.47E-10	3.53E-16	2.51E-10	3.58E-16
Benzofuran	4.74E-10	6.77E-16	4.81E-10	6.87E-16
Benzoic Acid	1.20E-10	1.71E-16	1.21E-10	1.73E-16
Benzonitrile	1.14E-13	1.63E-19	1.15E-13	1.65E-19
Carbazole	2.28E-14	3.25E-20	2.31E-14	3.30E-20
4-Chlorobiphenyl	1.38E-10	1.96E-16	1.40E-10	1.99E-16
4,4-Chlorobiphenyl	1.80E-12	2.57E-18	1.83E-12	2.61E-18
4-Chlorophenylmethylsulfone	9.15E-16	1.31E-21	2.40E-14	3.43E-20
4-Chlorophenylmethylsulfoxide	3.41E-15	4.87E-21	8.94E-14	1.28E-19
p,p-DDE	3.74E-12	5.34E-18	1.88E-11	2.68E-17
p,p-DDT	7.49E-16	1.07E-21	3.76E-15	5.37E-21
Dibenzofuran	2.37E-11	3.38E-17	2.40E-11	3.43E-17
Dieldrin	2.47E-15	3.53E-21	2.51E-15	3.59E-21
Diisopropyl Methylphosphonate	1.81E-14	2.59E-20	3.17E-13	4.53E-19
1,3-Dimethylbenzene	4.74E-11	6.77E-17	4.81E-11	6.87E-17
Dimethyl Methylphosphonate	7.14E-15	1.02E-20	2.50E-13	3.57E-19
Dimethylphosphate	2.84E-12	4.06E-18	2.88E-12	4.12E-18
Dioxins/Furans (EPA TEFs)	1.78E-12	2.55E-18	6.93E-12	9.91E-18
Dithiane	4.35E-16	6.21E-22	4.41E-16	6.30E-22
Endrin	4.97E-16	7.10E-22	2.27E-15	3.25E-21
Hexachlorobenzene	1.01E-13	1.44E-19	7.30E-13	1.04E-18
Hexachlorocyclopentadiene	2.24E-14	3.20E-20	2.27E-14	3.25E-20
Isodrin	6.34E-15	9.06E-21	6.44E-15	9.19E-21
Malathion	9.68E-15	1.38E-20	9.82E-15	1.40E-20
Methanol	2.75E-10	3.93E-16	2.79E-10	3.99E-16
4-Nitrophenol	1.00E-13	1.43E-19	1.02E-13	1.45E-19
PAHs				
Acenaphthalene	1.19E-10	1.69E-16	1.20E-10	1.72E-16
Acenaphthene	1.19E-10	1.69E-16	1.20E-10	1.72E-16
Benzo(a)pyrene	4.17E-13	5.96E-19	1.18E-11	1.68E-17
Chrysene	5.23E-13	7.47E-19	1.33E-11	1.91E-17
Dibenzo(a,h)anthracene	5.67E-13	8.11E-19	1.39E-11	1.99E-17
Fluoranthene	1.53E-12	2.19E-18	3.96E-11	5.65E-17
Fluorene	2.37E-11	3.38E-17	2.40E-11	3.43E-17
Phenanthrene	7.24E-13	1.03E-18	2.15E-11	3.07E-17
Pyrene	3.51E-13	5.01E-19	1.05E-11	1.50E-17
Parathion	1.34E-15	1.91E-21	1.36E-15	1.94E-21
Pentachlorobenzene	3.62E-13	5.17E-19	3.67E-13	5.24E-19
Phenol	1.28E-09	1.83E-15	1.30E-09	1.86E-15
Quinoline	5.67E-14	8.09E-20	5.75E-14	8.21E-20

Table 8D-1

(continued)

DRAFT

Supona	4.01E-15	5.73E-21	4.07E-15	5.82E-21
Tetrachlorobenzene	1.53E-13	2.18E-19	1.55E-13	2.21E-19
Trichlorobenzene	8.04E-14	1.15E-19	8.15E-14	1.16E-19
Urea	1.74E-09	2.48E-15	1.76E-09	2.52E-15
Vapona	1.07E-14	1.53E-20	1.09E-14	1.55E-20
INORGANICS				
Antimony	1.10E-06	1.58E-12	1.12E-06	1.60E-12
Arsenic	6.25E-06	8.92E-12	6.34E-06	9.05E-12
Barium	1.53E-06	2.19E-12	1.55E-06	2.22E-12
Beryllium	6.39E-08	9.13E-14	6.48E-08	9.26E-14
Copper	5.86E-03	8.37E-09	5.94E-03	8.49E-09
Lead	1.96E-06	2.80E-12	1.99E-06	2.84E-12
Mercury	1.73E-06	2.47E-12	1.75E-06	2.51E-12
Selenium	1.60E-02	2.29E-08	1.63E-02	2.32E-08
Silver	1.66E-04	2.37E-10	1.68E-04	2.41E-10
Thallium	1.61E-05	2.30E-11	1.64E-05	2.34E-11

Annual average soil/dust ingestion rate (100 mg/day)
Exposure frequency (365 days/year)
Body weight (70 kg)

Table 8D-2

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Adult, Resident-B Scenario

	--------AVERAGE---------		--------MAXIMUM---------	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	1.65E-12	2.35E-18	1.67E-12	2.38E-18
Aldrin	1.74E-14	2.49E-20	1.77E-14	2.53E-20
Atrazine	4.03E-17	5.75E-23	1.32E-15	1.89E-21
Benzaldehyde	3.57E-10	5.10E-16	3.62E-10	5.17E-16
Benzofuran	6.85E-10	9.79E-16	6.95E-10	9.93E-16
Benzoic Acid	1.73E-10	2.47E-16	1.75E-10	2.51E-16
Benzonitrile	1.65E-13	2.35E-19	1.67E-13	2.38E-19
Carbazole	3.29E-14	4.70E-20	3.34E-14	4.77E-20
4-Chlorobiphenyl	1.99E-10	2.84E-16	2.02E-10	2.88E-16
4,4-Chlorobiphenyl	2.60E-12	3.72E-18	2.64E-12	3.77E-18
4-Chlorophenylmethylsulfone	1.32E-15	1.89E-21	3.47E-14	4.96E-20
4-Chlorophenylmethylsulfoxide	4.92E-15	7.03E-21	1.29E-13	1.85E-19
p,p-DDE	5.41E-12	7.73E-18	2.72E-11	3.88E-17
p,p-DDT	1.08E-15	1.55E-21	5.44E-15	7.77E-21
Dibenzofuran	3.42E-11	4.89E-17	3.47E-11	4.96E-17
Dieldrin	3.58E-15	5.11E-21	3.63E-15	5.18E-21
Diisopropyl Methylphosphonate	2.62E-14	3.74E-20	4.58E-13	6.55E-19
1,3-Dimethylbenzene	6.85E-11	9.79E-17	6.95E-11	9.93E-17
Dimethyl Methylphosphonate	1.03E-14	1.47E-20	3.61E-13	5.16E-19
Dimethylphosphate	4.11E-12	5.87E-18	4.17E-12	5.96E-18
Dioxins/Furans (EPA TEFs)	2.58E-12	3.68E-18	1.00E-11	1.43E-17
Dithiane	6.29E-16	8.98E-22	6.38E-16	9.11E-22
Endrin	7.19E-16	1.03E-21	3.28E-15	4.69E-21
Hexachlorobenzene	1.46E-13	2.09E-19	1.06E-12	1.51E-18
Hexachlorocyclopentadiene	3.24E-14	4.63E-20	3.29E-14	4.70E-20
Isodrin	9.17E-15	1.31E-20	9.30E-15	1.33E-20
Malathion	1.40E-14	2.00E-20	1.42E-14	2.03E-20
Methanol	3.98E-10	5.68E-16	4.03E-10	5.76E-16
4-Nitrophenol	1.45E-13	2.07E-19	1.47E-13	2.10E-19
PAHs				
Acenaphthalene	1.72E-10	2.45E-16	1.74E-10	2.49E-16
Acenaphthene	1.72E-10	2.45E-16	1.74E-10	2.49E-16
Benzo(a)pyrene	6.03E-13	8.62E-19	1.70E-11	2.43E-17
Chrysene	7.55E-13	1.08E-18	1.93E-11	2.76E-17
Dibenzo(a,h)anthracene	8.20E-13	1.17E-18	2.01E-11	2.87E-17
Fluoranthene	2.21E-12	3.16E-18	5.72E-11	8.17E-17
Fluorene	3.42E-11	4.89E-17	3.47E-11	4.96E-17
Phenanthrene	1.05E-12	1.50E-18	3.11E-11	4.44E-17
Pyrene	5.07E-13	7.25E-19	1.52E-11	2.17E-17
Parathion	1.93E-15	2.76E-21	1.96E-15	2.80E-21
Pentachlorobenzene	5.23E-13	7.47E-19	5.31E-13	7.58E-19
Phenol	1.86E-09	2.65E-15	1.88E-09	2.69E-15
Quinoline	8.19E-14	1.17E-19	8.31E-14	1.19E-19

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Table 8D-2

(continued)

Supona	5.80E-15	8.29E-21	5.89E-15	8.41E-21
Tetrachlorobenzene	2.21E-13	3.15E-19	2.24E-13	3.20E-19
Trichlorobenzene	1.16E-13	1.66E-19	1.18E-13	1.68E-19
Urea	2.51E-09	3.59E-15	2.55E-09	3.64E-15
Vapona	1.55E-14	2.21E-20	1.57E-14	2.24E-20
INORGANICS				
Antimony	1.60E-06	2.28E-12	1.62E-06	2.31E-12
Arsenic	9.03E-06	1.29E-11	9.16E-06	1.31E-11
Barium	2.21E-06	3.16E-12	2.24E-06	3.21E-12
Beryllium	9.24E-08	1.32E-13	9.37E-08	1.34E-13
Copper	8.47E-03	1.21E-08	8.59E-03	1.23E-08
Lead	2.84E-06	4.05E-12	2.88E-06	4.11E-12
Mercury	2.50E-06	3.57E-12	2.54E-06	3.62E-12
Selenium	2.32E-02	3.31E-08	2.35E-02	3.36E-08
Silver	2.40E-04	3.43E-10	2.44E-04	3.48E-10
Thallium	2.33E-05	3.33E-11	2.36E-05	3.38E-11

Annual average soil/dust ingestion rate (100 mg/day)
Exposure frequency (365 days/year)
Body weight (70 kg)

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Table 8D-3

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Adult, Farmer Scenario

	AVERAGE C soil CALCULATED CONC IN SOIL .1M mg/Kg	AVERAGE EDI ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM C soil CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	9.75E-13	1.39E-18	9.89E-13	1.41E-18
Aldrin	1.03E-14	1.48E-20	1.05E-14	1.50E-20
Atrazine	2.39E-17	3.41E-23	7.83E-16	1.12E-21
Benzaldehyde	2.12E-10	3.02E-16	2.15E-10	3.07E-16
Benzofuran	4.06E-10	5.80E-16	4.12E-10	5.89E-16
Benzoic Acid	1.03E-10	1.46E-16	1.04E-10	1.49E-16
Benzonitrile	9.75E-14	1.39E-19	9.89E-14	1.41E-19
Carbazole	1.95E-14	2.79E-20	1.98E-14	2.83E-20
4-Chlorobiphenyl	1.18E-10	1.68E-16	1.20E-10	1.71E-16
4,4-Chlorobiphenyl	1.54E-12	2.21E-18	1.57E-12	2.24E-18
4-Chlorophenylmethylsulfone	7.84E-16	1.12E-21	2.06E-14	2.94E-20
4-Chlorophenylmethylsulfoxide	2.92E-15	4.17E-21	7.66E-14	1.09E-19
p,p-DDE	3.21E-12	4.58E-18	1.61E-11	2.30E-17
p,p-DDT	6.42E-16	9.17E-22	3.22E-15	4.60E-21
Dibenzofuran	2.03E-11	2.90E-17	2.06E-11	2.94E-17
Dieldrin	2.12E-15	3.03E-21	2.15E-15	3.07E-21
Diisopropyl Methylphosphonate	1.55E-14	2.22E-20	2.72E-13	3.88E-19
1,3-Dimethylbenzene	4.06E-11	5.80E-17	4.12E-11	5.89E-17
Dimethyl Methylphosphonate	6.12E-15	8.74E-21	2.14E-13	3.06E-19
Dimethylphosphate	2.44E-12	3.48E-18	2.47E-12	3.53E-18
Dioxins/Furans (EPA TEFs)	1.53E-12	2.18E-18	5.94E-12	8.49E-18
Dithiane	3.73E-16	5.32E-22	3.78E-16	5.40E-22
Endrin	4.26E-16	6.09E-22	1.95E-15	2.78E-21
Hexachlorobenzene	8.66E-14	1.24E-19	6.26E-13	8.94E-19
Hexachlorocyclopentadiene	1.92E-14	2.75E-20	1.95E-14	2.78E-20
Isodrin	5.44E-15	7.77E-21	5.52E-15	7.88E-21
Malathion	8.30E-15	1.19E-20	8.42E-15	1.20E-20
Methanol	2.36E-10	3.37E-16	2.39E-10	3.42E-16
4-Nitrophenol	8.59E-14	1.23E-19	8.72E-14	1.25E-19
PAHs				
Acenaphthalene	1.02E-10	1.45E-16	1.03E-10	1.47E-16
Acenaphthene	1.02E-10	1.45E-16	1.03E-10	1.47E-16
Benzo(a)pyrene	3.58E-13	5.11E-19	1.01E-11	1.44E-17
Chrysene	4.48E-13	6.40E-19	1.14E-11	1.63E-17
Dibenzo(a,h)anthracene	4.86E-13	6.95E-19	1.19E-11	1.70E-17
Fluoranthene	1.31E-12	1.87E-18	3.39E-11	4.85E-17
Fluorene	2.03E-11	2.90E-17	2.06E-11	2.94E-17
Phenanthrene	6.21E-13	8.87E-19	1.84E-11	2.63E-17
Pyrene	3.01E-13	4.30E-19	9.02E-12	1.29E-17
Parathion	1.15E-15	1.64E-21	1.16E-15	1.66E-21
Pentachlorobenzene	3.10E-13	4.43E-19	3.15E-13	4.49E-19
Phenol	1.10E-09	1.57E-15	1.12E-09	1.59E-15
Quinoline	4.86E-14	6.94E-20	4.93E-14	7.04E-20

DRAFT

Table 8D-3

(continued)

Supona	3.44E-15	4.92E-21	3.49E-15	4.99E-21
Tetrachlorobenzene	1.31E-13	1.87E-19	1.33E-13	1.89E-19
Trichlorobenzene	6.89E-14	9.84E-20	6.99E-14	9.98E-20
Urea	1.49E-09	2.13E-15	1.51E-09	2.16E-15
Vapona	9.17E-15	1.31E-20	9.31E-15	1.33E-20
INORGANICS				
Antimony	9.46E-07	1.35E-12	9.60E-07	1.37E-12
Arsenic	5.35E-06	7.65E-12	5.43E-06	7.76E-12
Barium	1.31E-06	1.87E-12	1.33E-06	1.90E-12
Beryllium	5.48E-08	7.83E-14	5.56E-08	7.94E-14
Copper	5.02E-03	7.17E-09	5.09E-03	7.28E-09
Lead	1.68E-06	2.40E-12	1.71E-06	2.44E-12
Mercury	1.48E-06	2.12E-12	1.50E-06	2.15E-12
Selenium	1.37E-02	1.96E-08	1.39E-02	1.99E-08
Silver	1.42E-04	2.03E-10	1.44E-04	2.06E-10
Thallium	1.38E-05	1.97E-11	1.40E-05	2.00E-11

Annual average soil/dust ingestion rate (100 mg/day)
Exposure frequency (365 days/year)
Body weight (70 kg)

Table 8D-4

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Adult, Worker Scenario

	--------AVERAGE--------		--------MAXIMUM--------	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	1.49E-12	6.57E-19	1.51E-12	6.67E-19
Aldrin	1.58E-14	6.96E-21	1.60E-14	7.06E-21
Atrazine	3.65E-17	1.61E-23	1.20E-15	5.27E-22
Benzaldehyde	3.24E-10	1.43E-16	3.29E-10	1.45E-16
Benzofuran	6.22E-10	2.74E-16	6.31E-10	2.78E-16
Benzoic Acid	1.57E-10	6.91E-17	1.59E-10	7.01E-17
Benzonitrile	1.49E-13	6.57E-20	1.51E-13	6.67E-20
Carbazole	2.98E-14	1.31E-20	3.03E-14	1.33E-20
4-Chlorobiphenyl	1.80E-10	7.94E-17	1.83E-10	8.06E-17
4,4-Chlorobiphenyl	2.36E-12	1.04E-18	2.40E-12	1.06E-18
4-Chlorophenylmethylsulfone	1.20E-15	5.28E-22	3.15E-14	1.39E-20
4-Chlorophenylmethylsulfoxide	4.47E-15	1.97E-21	1.17E-13	5.16E-20
p,p-DDE	4.90E-12	2.16E-18	2.46E-11	1.08E-17
p,p-DDT	9.82E-16	4.32E-22	4.93E-15	2.17E-21
Dibenzofuran	3.11E-11	1.37E-17	3.15E-11	1.39E-17
Dieldrin	3.24E-15	1.43E-21	3.29E-15	1.45E-21
Diisopropyl Methylphosphonate	2.37E-14	1.05E-20	4.16E-13	1.83E-19
1,3-Dimethylbenzene	6.22E-11	2.74E-17	6.31E-11	2.78E-17
Dimethyl Methylphosphonate	9.36E-15	4.12E-21	3.28E-13	1.44E-19
Dimethylphosphate	3.73E-12	1.64E-18	3.78E-12	1.67E-18
Dioxins/Furans (EPA TEFs)	2.34E-12	1.03E-18	9.09E-12	4.00E-18
Dithiane	5.70E-16	2.51E-22	5.79E-16	2.55E-22
Endrin	6.52E-16	2.87E-22	2.98E-15	1.31E-21
Hexachlorobenzene	1.32E-13	5.83E-20	9.57E-13	4.21E-19
Hexachlorocyclopentadiene	2.94E-14	1.29E-20	2.98E-14	1.31E-20
Isodrin	8.32E-15	3.66E-21	8.44E-15	3.72E-21
Malathion	1.27E-14	5.59E-21	1.29E-14	5.67E-21
Methanol	3.61E-10	1.59E-16	3.66E-10	1.61E-16
4-Nitrophenol	1.31E-13	5.79E-20	1.33E-13	5.87E-20
PAHs				
Acenaphthalene	1.56E-10	6.85E-17	1.58E-10	6.95E-17
Acenaphthene	1.56E-10	6.85E-17	1.58E-10	6.95E-17
Benzo(a)pyrene	5.47E-13	2.41E-19	1.54E-11	6.79E-18
Chrysene	6.85E-13	3.02E-19	1.75E-11	7.71E-18
Dibenzo(a,h)anthracene	7.44E-13	3.28E-19	1.82E-11	8.03E-18
Fluoranthene	2.01E-12	8.84E-19	5.19E-11	2.28E-17
Fluorene	3.11E-11	1.37E-17	3.15E-11	1.39E-17
Phenanthrene	9.50E-13	4.18E-19	2.82E-11	1.24E-17
Pyrene	4.60E-13	2.03E-19	1.38E-11	6.08E-18
Parathion	1.75E-15	7.72E-22	1.78E-15	7.83E-22
Pentachlorobenzene	4.74E-13	2.09E-19	4.81E-13	2.12E-19
Phenol	1.68E-09	7.41E-16	1.71E-09	7.52E-16
Quinoline	7.43E-14	3.27E-20	7.54E-14	3.32E-20

DRAFT

Table 8D-4

(continued)

Supona	5.26E-15	2.32E-21	5.34E-15	2.35E-21
Tetrachlorobenzene	2.00E-13	8.81E-20	2.03E-13	8.94E-20
Trichlorobenzene	1.05E-13	4.64E-20	1.07E-13	4.71E-20
Urea	2.28E-09	1.00E-15	2.31E-09	1.02E-15
Vapona	1.40E-14	6.18E-21	1.42E-14	6.27E-21
INORGANICS				
Antimony	1.45E-06	6.37E-13	1.47E-06	6.47E-13
Arsenic	8.19E-06	3.61E-12	8.31E-06	3.66E-12
Barium	2.01E-06	8.84E-13	2.04E-06	8.96E-13
Beryllium	8.38E-08	3.69E-14	8.50E-08	3.74E-14
Copper	7.68E-03	3.38E-09	7.79E-03	3.43E-09
Lead	2.57E-06	1.13E-12	2.61E-06	1.15E-12
Mercury	2.27E-06	9.98E-13	2.30E-06	1.01E-12
Selenium	2.10E-02	9.25E-09	2.13E-02	9.39E-09
Silver	2.18E-04	9.59E-11	2.21E-04	9.73E-11
Thallium	2.11E-05	9.31E-12	2.15E-05	9.45E-12

Annual average soil/dust ingestion rate (50 mg/day)
Exposure frequency (225 days/year)
Body weight (70 kg)

Table 8D-5

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Child, Resident-A Scenario

	--------AVERAGE---------		--------MAXIMUM---------	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	1.14E-12	1.47E-17	1.15E-12	1.49E-17
Aldrin	1.21E-14	1.56E-19	1.22E-14	1.58E-19
Atrazine	2.78E-17	3.59E-22	9.14E-16	1.18E-20
Benzaldehyde	2.47E-10	3.19E-15	2.51E-10	3.23E-15
Benzofuran	4.74E-10	6.12E-15	4.81E-10	6.21E-15
Benzoic Acid	1.20E-10	1.54E-15	1.21E-10	1.57E-15
Benzonitrile	1.14E-13	1.47E-18	1.15E-13	1.49E-18
Carbazole	2.28E-14	2.94E-19	2.31E-14	2.98E-19
4-Chlorobiphenyl	1.38E-10	1.77E-15	1.40E-10	1.80E-15
4,4-Chlorobiphenyl	1.80E-12	2.32E-17	1.83E-12	2.36E-17
4-Chlorophenylmethylsulfone	9.15E-16	1.18E-20	2.40E-14	3.10E-19
4-Chlorophenylmethylsulfoxide	3.41E-15	4.40E-20	8.94E-14	1.15E-18
p,p-DDE	3.74E-12	4.83E-17	1.88E-11	2.42E-16
p,p-DDT	7.49E-16	9.67E-21	3.76E-15	4.85E-20
Dibenzofuran	2.37E-11	3.06E-16	2.40E-11	3.10E-16
Dieldrin	2.47E-15	3.19E-20	2.51E-15	3.24E-20
Diisopropyl Methylphosphonate	1.81E-14	2.34E-19	3.17E-13	4.09E-18
1,3-Dimethylbenzene	4.74E-11	6.12E-16	4.81E-11	6.21E-16
Dimethyl Methylphosphonate	7.14E-15	9.21E-20	2.50E-13	3.22E-18
Dimethylphosphate	2.84E-12	3.67E-17	2.88E-12	3.72E-17
Dioxins/Furans (EPA TEFs)	1.78E-12	2.30E-17	6.93E-12	8.95E-17
Dithiane	4.35E-16	5.61E-21	4.41E-16	5.69E-21
Endrin	4.97E-16	6.42E-21	2.27E-15	2.93E-20
Hexachlorobenzene	1.01E-13	1.30E-18	7.30E-13	9.42E-18
Hexachlorocyclopentadiene	2.24E-14	2.89E-19	2.27E-14	2.93E-19
Isodrin	6.34E-15	8.18E-20	6.44E-15	8.30E-20
Malathion	9.68E-15	1.25E-19	9.82E-15	1.27E-19
Methanol	2.75E-10	3.55E-15	2.79E-10	3.60E-15
4-Nitrophenol	1.00E-13	1.29E-18	1.02E-13	1.31E-18
PAHs				
Acenaphthalene	1.19E-10	1.53E-15	1.20E-10	1.55E-15
Acenaphthene	1.19E-10	1.53E-15	1.20E-10	1.55E-15
Benzo(a)pyrene	4.17E-13	5.38E-18	1.18E-11	1.52E-16
Chrysene	5.23E-13	6.75E-18	1.33E-11	1.72E-16
Dibenzo(a,h)anthracene	5.67E-13	7.32E-18	1.39E-11	1.79E-16
Fluoranthene	1.53E-12	1.97E-17	3.96E-11	5.11E-16
Fluorene	2.37E-11	3.06E-16	2.40E-11	3.10E-16
Phenanthrene	7.24E-13	9.34E-18	2.15E-11	2.78E-16
Pyrene	3.51E-13	4.53E-18	1.05E-11	1.36E-16
Parathion	1.34E-15	1.72E-20	1.36E-15	1.75E-20
Pentachlorobenzene	3.62E-13	4.67E-18	3.67E-13	4.73E-18
Phenol	1.28E-09	1.66E-14	1.30E-09	1.68E-14
Quinoline	5.67E-14	7.31E-19	5.75E-14	7.42E-19

DRAFT

Table 8D-5

(continued)

Supona	4.01E-15	5.18E-20	4.07E-15	5.25E-20
Tetrachlorobenzene	1.53E-13	1.97E-18	1.55E-13	2.00E-18
Trichlorobenzene	8.04E-14	1.04E-18	8.15E-14	1.05E-18
Urea	1.74E-09	2.24E-14	1.76E-09	2.28E-14
Vapona	1.07E-14	1.38E-19	1.09E-14	1.40E-19
INORGANICS				
Antimony	1.10E-06	1.42E-11	1.12E-06	1.45E-11
Arsenic	6.25E-06	8.06E-11	6.34E-06	8.18E-11
Barium	1.53E-06	1.97E-11	1.55E-06	2.00E-11
Beryllium	6.39E-08	8.25E-13	6.48E-08	8.37E-13
Copper	5.86E-03	7.56E-08	5.94E-03	7.67E-08
Lead	1.96E-06	2.53E-11	1.99E-06	2.57E-11
Mercury	1.73E-06	2.23E-11	1.75E-06	2.26E-11
Selenium	1.60E-02	2.07E-07	1.63E-02	2.10E-07
Silver	1.66E-04	2.14E-09	1.68E-04	2.17E-09
Thallium	1.61E-05	2.08E-10	1.64E-05	2.11E-10

Annual average soil/dust ingestion rate (200 mg/day)
Exposure frequency (365 days/year)
Body weight (15.5 kg)

Table 8D-6

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Child, Resident-B Scenario

	AVERAGE		MAXIMUM	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	1.65E-12	2.12E-17	1.67E-12	2.15E-17
Aldrin	1.74E-14	2.25E-19	1.77E-14	2.28E-19
Atrazine	4.03E-17	5.19E-22	1.32E-15	1.70E-20
Benzaldehyde	3.57E-10	4.61E-15	3.62E-10	4.67E-15
Benzofuran	6.85E-10	8.84E-15	6.95E-10	8.97E-15
Benzoic Acid	1.73E-10	2.23E-15	1.75E-10	2.26E-15
Benzonitrile	1.65E-13	2.12E-18	1.67E-13	2.15E-18
Carbazole	3.29E-14	4.25E-19	3.34E-14	4.31E-19
4-Chlorobiphenyl	1.99E-10	2.57E-15	2.02E-10	2.60E-15
4,4-Chlorobiphenyl	2.60E-12	3.36E-17	2.64E-12	3.41E-17
4-Chlorophenylmethylsulfone	1.32E-15	1.71E-20	3.47E-14	4.48E-19
4-Chlorophenylmethylsulfoxide	4.92E-15	6.35E-20	1.29E-13	1.67E-18
p,p-DDE	5.41E-12	6.98E-17	2.72E-11	3.50E-16
p,p-DDT	1.08E-15	1.40E-20	5.44E-15	7.02E-20
Dibenzofuran	3.42E-11	4.42E-16	3.47E-11	4.48E-16
Dieldrin	3.58E-15	4.62E-20	3.63E-15	4.68E-20
Diisopropyl Methylphosphonate	2.62E-14	3.38E-19	4.58E-13	5.91E-18
1,3-Dimethylbenzene	6.85E-11	8.84E-16	6.95E-11	8.97E-16
Dimethyl Methylphosphonate	1.03E-14	1.33E-19	3.61E-13	4.66E-18
Dimethylphosphate	4.11E-12	5.30E-17	4.17E-12	5.38E-17
Dioxins/Furans (EPA TEFs)	2.58E-12	3.32E-17	1.00E-11	1.29E-16
Dithiane	6.29E-16	8.11E-21	6.38E-16	8.23E-21
Endrin	7.19E-16	9.27E-21	3.28E-15	4.24E-20
Hexachlorobenzene	1.46E-13	1.89E-18	1.06E-12	1.36E-17
Hexachlorocyclopentadiene	3.24E-14	4.18E-19	3.29E-14	4.24E-19
Isodrin	9.17E-15	1.18E-19	9.30E-15	1.20E-19
Malathion	1.40E-14	1.81E-19	1.42E-14	1.83E-19
Methanol	3.98E-10	5.13E-15	4.03E-10	5.20E-15
4-Nitrophenol	1.45E-13	1.87E-18	1.47E-13	1.90E-18
PAHs				
Acenaphthalene	1.72E-10	2.21E-15	1.74E-10	2.25E-15
Acenaphthene	1.72E-10	2.21E-15	1.74E-10	2.25E-15
Benzo(a)pyrene	6.03E-13	7.78E-18	1.70E-11	2.19E-16
Chrysene	7.55E-13	9.75E-18	1.93E-11	2.49E-16
Dibenzo(a,h)anthracene	8.20E-13	1.06E-17	2.01E-11	2.59E-16
Fluoranthene	2.21E-12	2.85E-17	5.72E-11	7.38E-16
Fluorene	3.42E-11	4.42E-16	3.47E-11	4.48E-16
Phenanthrene	1.05E-12	1.35E-17	3.11E-11	4.01E-16
Pyrene	5.07E-13	6.55E-18	1.52E-11	1.96E-16
Parathion	1.93E-15	2.49E-20	1.96E-15	2.53E-20
Pentachlorobenzene	5.23E-13	6.75E-18	5.31E-13	6.85E-18
Phenol	1.86E-09	2.39E-14	1.88E-09	2.43E-14
Quinoline	8.19E-14	1.06E-18	8.31E-14	1.07E-18

Table 8D-6

(continued)

DRAFT

Supona	5.80E-15	7.49E-20	5.89E-15	7.60E-20
Tetrachlorobenzene	2.21E-13	2.85E-18	2.24E-13	2.89E-18
Trichlorobenzene	1.16E-13	1.50E-18	1.18E-13	1.52E-18
Urea	2.51E-09	3.24E-14	2.55E-09	3.29E-14
Vapona	1.55E-14	2.00E-19	1.57E-14	2.03E-19
INORGANICS				
Antimony	1.60E-06	2.06E-11	1.62E-06	2.09E-11
Arsenic	9.03E-06	1.17E-10	9.16E-06	1.18E-10
Barium	2.21E-06	2.85E-11	2.24E-06	2.90E-11
Beryllium	9.24E-08	1.19E-12	9.37E-08	1.21E-12
Copper	8.47E-03	1.09E-07	8.59E-03	1.11E-07
Lead	2.84E-06	3.66E-11	2.88E-06	3.71E-11
Mercury	2.50E-06	3.22E-11	2.54E-06	3.27E-11
Selenium	2.32E-02	2.99E-07	2.35E-02	3.03E-07
Silver	2.40E-04	3.10E-09	2.44E-04	3.14E-09
Thallium	2.33E-05	3.01E-10	2.36E-05	3.05E-10

Annual average soil/dust ingestion rate (200 mg/day)
Exposure frequency (365 days/year)
Body weight (15.5 kg)

Table 8D-7

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Soil/Dust Ingestion Route of Exposure Child, Farmer Scenario

	--------AVERAGE--------		--------MAXIMUM--------	
	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day	C soil CALCULATED CONC IN SOIL .1M mg/Kg	EDI ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS				
Acetonitrile	9.75E-13	1.26E-17	9.89E-13	1.28E-17
Aldrin	1.03E-14	1.33E-19	1.05E-14	1.35E-19
Atrazine	2.39E-17	3.08E-22	7.83E-16	1.01E-20
Benzaldehyde	2.12E-10	2.73E-15	2.15E-10	2.77E-15
Benzofuran	4.06E-10	5.24E-15	4.12E-10	5.32E-15
Benzoic Acid	1.03E-10	1.32E-15	1.04E-10	1.34E-15
Benzonitrile	9.75E-14	1.26E-18	9.89E-14	1.28E-18
Carbazole	1.95E-14	2.52E-19	1.98E-14	2.55E-19
4-Chlorobiphenyl	1.18E-10	1.52E-15	1.20E-10	1.54E-15
4,4-Chlorobiphenyl	1.54E-12	1.99E-17	1.57E-12	2.02E-17
4-Chlorophenylmethylsulfone	7.84E-16	1.01E-20	2.06E-14	2.66E-19
4-Chlorophenylmethylsulfoxide	2.92E-15	3.77E-20	7.66E-14	9.89E-19
p,p-DDE	3.21E-12	4.14E-17	1.61E-11	2.08E-16
p,p-DDT	6.42E-16	8.28E-21	3.22E-15	4.16E-20
Dibenzofuran	2.03E-11	2.62E-16	2.06E-11	2.66E-16
Dieldrin	2.12E-15	2.74E-20	2.15E-15	2.78E-20
Diisopropyl Methylphosphonate	1.55E-14	2.00E-19	2.72E-13	3.51E-18
1,3-Dimethylbenzene	4.06E-11	5.24E-16	4.12E-11	5.32E-16
Dimethyl Methylphosphonate	6.12E-15	7.89E-20	2.14E-13	2.76E-18
Dimethylphosphate	2.44E-12	3.14E-17	2.47E-12	3.19E-17
Dioxins/Furans (EPA TEFs)	1.53E-12	1.97E-17	5.94E-12	7.67E-17
Dithiane	3.73E-16	4.81E-21	3.78E-16	4.88E-21
Endrin	4.26E-16	5.50E-21	1.95E-15	2.51E-20
Hexachlorobenzene	8.66E-14	1.12E-18	6.26E-13	8.07E-18
Hexachlorocyclopentadiene	1.92E-14	2.48E-19	1.95E-14	2.52E-19
Isodrin	5.44E-15	7.02E-20	5.52E-15	7.12E-20
Malathion	8.30E-15	1.07E-19	8.42E-15	1.09E-19
Methanol	2.36E-10	3.04E-15	2.39E-10	3.09E-15
4-Nitrophenol	8.59E-14	1.11E-18	8.72E-14	1.12E-18
PAHs				
Acenaphthalene	1.02E-10	1.31E-15	1.03E-10	1.33E-15
Acenaphthene	1.02E-10	1.31E-15	1.03E-10	1.33E-15
Benzo(a)pyrene	3.58E-13	4.61E-18	1.01E-11	1.30E-16
Chrysene	4.48E-13	5.78E-18	1.14E-11	1.48E-16
Dibenzo(a,h)anthracene	4.86E-13	6.27E-18	1.19E-11	1.54E-16
Fluoranthene	1.31E-12	1.69E-17	3.39E-11	4.38E-16
Fluorene	2.03E-11	2.62E-16	2.06E-11	2.66E-16
Phenanthrene	6.21E-13	8.01E-18	1.84E-11	2.38E-16
Pyrene	3.01E-13	3.88E-18	9.02E-12	1.16E-16
Parathion	1.15E-15	1.48E-20	1.16E-15	1.50E-20
Pentachlorobenzene	3.10E-13	4.00E-18	3.15E-13	4.06E-18
Phenol	1.10E-09	1.42E-14	1.12E-09	1.44E-14
Quinoline	4.86E-14	6.27E-19	4.93E-14	6.36E-19

Table 8D-7

(continued)

DRAFT

Supona	3.44E-15	4.44E-20	3.49E-15	4.50E-20
Tetrachlorobenzene	1.31E-13	1.69E-18	1.33E-13	1.71E-18
Trichlorobenzene	6.89E-14	8.89E-19	6.99E-14	9.02E-19
Urea	1.49E-09	1.92E-14	1.51E-09	1.95E-14
Vapona	9.17E-15	1.18E-19	9.31E-15	1.20E-19
INORGANICS				
Antimony	9.46E-07	1.22E-11	9.60E-07	1.24E-11
Arsenic	5.35E-06	6.91E-11	5.43E-06	7.01E-11
Barium	1.31E-06	1.69E-11	1.33E-06	1.72E-11
Beryllium	5.48E-08	7.07E-13	5.56E-08	7.17E-13
Copper	5.02E-03	6.48E-08	5.09E-03	6.57E-08
Lead	1.68E-06	2.17E-11	1.71E-06	2.20E-11
Mercury	1.48E-06	1.91E-11	1.50E-06	1.94E-11
Selenium	1.37E-02	1.77E-07	1.39E-02	1.80E-07
Silver	1.42E-04	1.84E-09	1.44E-04	1.86E-09
Thallium	1.38E-05	1.78E-10	1.40E-05	1.81E-10

Annual average soil/dust ingestion rate (200 mg/day)
Exposure frequency (365 days/year)
Body weight (15.5 kg)

APPENDIX 8E

CALCULATION OF THE ESTIMATED DAILY INTAKE FOR THE FISH INGESTION ROUTE OF EXPOSURE

APPENDIX 8E

CALCULATION OF THE ESTIMATED DAILY INTAKE FOR THE FISH INGESTION ROUTE OF EXPOSURE

The accumulation of substances in fish tissue involves the processes of bioconcentration and biomagnification. The bioconcentration of pollutants generally refers to the uptake of pollutants from water, primarily through passive transport across the gill membrane. Thus, the bioconcentration factor (BCF) describes the equilibrium between the pollutant concentration in the fish tissue and the pollutant concentration in the water. Bioaccumulation is similar to bioconcentration, however, bioaccumulation is a broader term that describes the uptake from both food and water (Clark et al., 1988). Biomagnification takes into account the relationship between the pollutant concentration in the fish tissue and the trophic transfer of pollutants. Thus, biomagnification refers to the accumulation of pollutants due to uptake of food through the food chain. Few data are presently available to verify pollutant uptake specific to biomagnification. Current investigations are attempting to address the contribution of biomagnification to total bioaccumulation (Connoly and Pedersen, 1988; McKay et al., 1986; Stevens, 1988). Most of the results are highly speculative.

Tissue pollutant concentrations increase until the rate of excretion is equal to the rate of uptake (i.e., a state of equilibrium is reached). At such a time, the body burden (fish tissue concentration) may be many times the concentration in the water. The BCF represents the ratio of pollutant concentration in tissue to the pollutant level in water at equilibrium.

BCFs were obtained for the pollutants of concern using the following procedure:

- The first step was to use BCFs currently recognized by the Environmental Protection Agency (EPA) for those pollutants of concern where available (EPA, 1989, 1987, 1986).

- If a BCF was not available through the EPA, additional sources (Verschueren, 1983; and Lyman et al., 1982) were searched for BCFs.

- For those organic chemicals for which no BCF was found, a BCF was calculated from the octanol-water partition coefficient (K_{ow}) and the soil adsorption coefficient (K_{oc}), where possible, using the following equations obtained from Lyman et al. (1982):

$$\log BCF = 0.76 \log K_{ow} - 0.23$$
$$\log BCF = 1.119 \log K_{oc} - 1.579$$

Where a BCF was able to be calculated from both a K_{ow} and a K_{oc}, the most conservative value (the highest BCF) was chosen for the pollutant. The specified input range for K_{ow} and K_{oc} in the regression equations is 7.9 to 8.1 x 10^6 mL/g and <1 to 1.2 x 10^6 mL/g, respectively. If a K_{ow} for a particular chemical was below the input range (7.9) and no other alternative existed for deriving a BCF, 7.9 was used to derive a conservative estimate of the BCF.

There was one organic compound (dimethyl phosphate) and eleven metals (aluminum, barium, boron, iron, lithium, magnesium, molybdenum, strontium, tin, titanium, and yittrium) for which BCFs were not available or could not be derived. However, the contribution of fish ingestion to the total carcinogenic risk varies from less than 1 percent to 1.2 percent for the various scenarios. In addition, the hazard index ranges from 5 to 6 orders of magnitude below one. Therefore, even if the BCFs for these chemicals are high, it is anticipated that their contribution to risk would be minimal.

A summary of the BCFs used for the pollutants of concern is presented in Table 8E-1. This table also presents where the BCFs were obtained or how they were derived.

At best, BCFs are approximations made through laboratory experiments, field studies, correlations with physico-chemical factors such as octanol/water partition coefficients, and models based on pollutant biokinetics coupled with fish metabolism (EPA, 1986). Normally, bioconcentration studies determine the average pollutant uptake as a function of the entire fish. However, for the evaluation of human exposure, consumption is generally restricted to the edible portion of the fish (i.e., with head, tail, and visceral mass removed). For this assessment, consumption of filleted fish was assumed.

Table 8E-1

Bioconcentration Factors (BCFs) Used for the Pollutants of Concern

Pollutant	BCF (L/kg)	Derivation[a]	References
ORGANICS			
Acetonitrile	0.06	OR	EPA, 1986
Aldrin	28	OR	EPA, 1986
Atrazine	0	OR	EPA, 1987
Benzaldehyde	8	log K_{ow} (1.48)	Verschueren, 1983
Benzofuran	63	log K_{ow} (2.67)	Verschueren, 1983
Benzoic Acid	15.5	log K_{ow} (1.87)	Verschueren, 1983
Benzonitrile	9	log K_{ow} (1.56)	Verschueren, 1983
Carbazole	186	log K_{ow} (3.29)	Verschueren, 1983
4-Chlorobiphenyl	590	OR	EPA, 1987
4,4-Chlorobiphenyl	215	OR	EPA, 1987
4-Chlorophenylmethylsulfone	6	K_{oc} (1.26)	Ebasco, 1990
4-Chlorophenylmethylsulfoxide	6	log K_{ow} (1.33)	Ebasco, 1990
p,p-DDE	51,000	OR	EPA,1986
p,p-DDT	54,000	OR	EPA, 1986
Dibenzofuran	796.5	log K_{ow} (4.12)	HSDB, 1990
Dieldrin	5,800	OR	EPA, 1987
Diisopropyl Methylphosphonate	12	log K_{ow} (1.73)	Ebasco, 1990
1,3-Dimethylbenzene	159	log K_{ow} (3.20)	Verschueren, 1983
Dimethyl Methylphosphonate	2.8	log K_{ow} (0.9)[b]	Lyman, et al., 1982
Dimethylphosphate	NTA	---	---
Dioxins/Furans (EPA TEFs)	5,000	OR	EPA, 1986
Dithiane	2.8	log K_{ow} (0.9)[b]	Lyman et al., 1982
Endrin	680	OR	EPA, 1987
Hexachlorobenzene	8,690	OR	EPA, 1986
Hexachlorocyclopentadiene	488	OR	EPA, 1987
Isodrin	52,000	log K_{ow} (6.51)	Ebasco, 1990
Malathion	0	OR	EPA, 1987
Methanol	2.8	log K_{ow} (0.9)[b]	Lyman et al., 1982
4-Nitrophenol	96	log K_{ow} (2.91)	EPA, 1989
PAHs			
Acenaphthalene	730	log K_{ow} (4.07)	EPA, 1986
Acenaphthene	242	OR	EPA, 1986
Benzo(a)pyrene	930	OR	EPA, 1987
Chrysene	23,000	K_{oc} (2.0E+05)	EPA, 1986
Dibenzo(a,h)anthracene	520,000	K_{oc} (3.3E+06)	EPA, 1986

Table 8E-1
(continued)

Pollutant	BCF (L/kg)	Derivation[a]	References
Fluorene	1,300	OR	EPA, 1986
Phenanthrene	2,630	OR	EPA, 1986
Pyrene	5,100	log K_{ow} (5.18)	EPA, 1986
Parathion	335	OR	EPA, 1987
Phenol	1.4	OR	EPA, 1986
Quinoline	21	log K_{ow} (2.03)	Verschueren, 1983
Supona	136	log K_{ow} (3.11)	Ebasco, 1990
Trichlorobenzene	991	OR[c]	EPA, 1987
Urea	2.8	log K_{ow} (0.9)[b]	Lyman et al., 1982
Vapona	7.0	log K_{ow}	Ebasco, 1990
INORGANICS			
Aluminum	NTA	---	---
Arsenic	350	OR	EPA, 1989
Barium	NTA	---	---
Beryllium	19	OR	EPA, 1986
Boron	NTA	---	---
Cadmium	326	OR	EPA, 1979
Chromium (VI)	155	OR	EPA, 1986
Cobalt	20	OR	Lyman et al., 1982
Copper	1,183	OR	EPA, 1989
Iron	NTA	---	---
Lead	180	OR	EPA, 1989
Lithium	NTA	---	---
Magnesium	NTA	---	---
Molybdenum	NTA	---	---
Selenium	16	OR	EPA, 1986
Silver	3,080	OR	EPA, 1979
Strontium	NTA	---	---
Tin	NTA	---	---
Titanium	NTA	---	---
Vanadium	10	OR	Lyman, et al., 1982
Yttrium	NTA	---	---
Zinc	578	OR	EPA, 1989

Table 8E-1
(continued)

Key:

K_{oc} - Soil adsorption coefficient
K_{ow} - Octanol-water partition coefficient
NTA - Not available
OR - BCF obtained directly from reference

[a]If a BCF could not be obtained from the EPA (1989, 1987, 1986) or other reference documents (Lyman, et al., 1982; Verschueren, 1983), a BCF was calculated, where appropriate, using values listed in this column as described in this appendix.

[b]Based on lower limitations of the regression equation.

[c]The average of the BCFs for two tricholobenzenes - 182 (1,2,4-trichlorobenzene), and 1800 (1,2,5-trichlorobenzene).

The pollutants present in the fish tissue are concentrated in lipids (fatty materials) found in those tissues. Thus, pollutant levels within the tissue are directly related to lipid concentration. A fillet lipid content of 10 percent was used to calculate adult and child estimated daily intakes.

Table 8E-2 presents the surface water contaminant concentrations, BCFs, and adult and child estimated daily intakes for the fish ingestion pathway.

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Table 8E-2

Daily Exposure to the Pollutants of Concern Through the Fish Ingestion Route of Exposure Adult and Child - Resident-A, Resident-B, and Farmer Scenarios

	SURFACE WATER CONCENTRAT. mg/L	BIO. CONC. FACTOR	ADULT ESTIMATED DAILY INTAKE mg/kg/day	CHILD ESTIMATED DAILY INTAKE mg/kg/day
ORGANICS				
Acetonitrile	2.03E-15	0.06	8.42E-22	1.90E-21
Aldrin	1.08E-18	28	2.08E-22	4.71E-22
Atrazine	2.31E-18	0	0.00E+00	0.00E+00
Benzaldehyde	4.17E-13	8	2.31E-17	5.21E-17
Benzofuran	4.58E-13	63	1.99E-16	4.50E-16
Benzoic Acid	1.87E-13	15.5	2.01E-17	4.53E-17
Benzonitrile	1.90E-16	9	1.18E-20	2.67E-20
Carbazole	9.91E-18	186	1.27E-20	2.88E-20
4-Chlorobiphenyl	1.37E-14	590	5.60E-17	1.26E-16
4,4-Chlorobiphenyl	1.65E-16	215	2.45E-19	5.53E-19
4-Chlorophenylmethylsulfone	7.11E-17	6	2.95E-21	6.66E-21
4-Chlorophenylmethylsulfoxide	2.62E-16	6	1.09E-20	2.45E-20
p,p-DDE	1.80E-15	51000	6.36E-16	1.44E-15
p,p-DDT	3.56E-19	54000	1.33E-19	3.00E-19
Dibenzofuran	3.58E-15	796.5	1.97E-17	4.45E-17
Dieldrin	2.22E-19	5800	8.91E-21	2.01E-20
Diisopropyl Methylphosphonate	6.76E-16	12	5.61E-20	1.27E-19
1,3-Dimethylbenzene	2.35E-14	159	2.58E-17	5.84E-17
Dimethyl Methylphosphonate	1.59E-14	2.8	3.07E-19	6.94E-19
Dimethylphosphate	5.07E-15			
Dioxins/Furans (EPA TEFs)	6.48E-16	5000	2.24E-17	5.06E-17
Dithiane	7.68E-19	2.8	1.49E-23	3.36E-23
Endrin	2.68E-19	680	1.26E-21	2.84E-21
Hexachlorobenzene	7.33E-17	8690	4.41E-18	9.95E-18
Hexachlorocyclopentadiene	2.06E-18	488	6.95E-21	1.57E-20
Isodrin	5.68E-19	52000	2.04E-19	4.61E-19
Malathion	7.30E-18	0	0.00E+00	0.00E+00
Methanol	4.91E-13	2.8	9.50E-18	2.15E-17
4-Nitrophenol	7.37E-17	96	4.89E-20	1.10E-19
PAHS				
Acenaphthalene	1.88E-14	730	9.49E-17	2.14E-16
Acenaphthene	2.20E-14	242	3.68E-17	8.31E-17
Benzo(a)pyrene	1.96E-15	930	1.26E-17	2.85E-17
Chrysene	2.01E-15	23000	3.19E-16	7.21E-16
Dibenzo(a,h)anthracene	1.99E-15	520000	7.16E-15	1.62E-14
Fluorene	2.93E-15	1300	2.64E-17	5.95E-17
Phenanthrene	4.87E-15	2630	8.86E-17	2.00E-16
Pyrene	2.06E-15	5100	7.27E-17	1.64E-16
Parathion	2.82E-19	335	6.54E-22	1.48E-21
Phenol	2.17E-12	1.4	2.10E-17	4.75E-17
Quinoline	8.42E-17	21	1.22E-20	2.76E-20
Supona	2.26E-18	136	2.13E-21	4.80E-21
Trichlorobenzene	1.40E-17	991	9.56E-20	2.16E-19
Urea	3.10E-12	2.8	6.01E-17	1.36E-16
Vapona	1.82E-17	7.0	8.82E-22	1.99E-21

Table 8E-2
(continued)

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INORGANICS				
Aluminum	3.10E-09			
Arsenic	6.16E-10	350	1.49E-11	3.37E-11
Barium	1.40E-10			
Beryllium	5.84E-12	19	7.67E-15	1.73E-14
Boron	4.60E-09			
Cadmium	1.68E-11	326	3.78E-13	8.53E-13
Chromium (VI)	1.34E-12	155	1.43E-14	3.23E-14
Cobalt	1.26E-10	20	1.74E-13	3.92E-13
Copper	5.48E-07	1183	4.48E-08	1.01E-07
Iron	7.61E-09			
Lead	1.83E-10	180	2.28E-12	5.15E-12
Lithium	1.75E-11			
Magnesium	2.27E-08			
Molybdenum	1.76E-09			
Selenium	1.58E-06	16	1.75E-09	3.95E-09
Silver	1.62E-08	3080	3.46E-09	7.80E-09
Strontium	5.84E-12			
Tin	1.32E-09			
Titanium	9.73E-12			
Vanadium	3.73E-10	10	2.58E-13	5.82E-13
Yittrium	3.41E-12			
Zinc	2.65E-09	578	1.06E-10	2.39E-10

Percent body lipid in fillet (10%)
Adult fish ingestion rate (4.84 g/day)
Child fish ingestion rate (2.42 g/day)
Adult body weight (70 kg)
Child body weight (15.5 kg)

APPENDIX 8E

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APPENDIX 8F

CALCULATION OF THE ESTIMATED DAILY INTAKE FOR THE DERMAL ABSORPTION ROUTE OF EXPOSURE

Table 8F-1

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure
Adult, Resident-A Scenario

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	5.69E-13	5.77E-13	1.00E-01	3.39E-20	3.44E-20
Aldrin	6.03E-15	6.12E-15	1.00E-01	3.59E-22	3.64E-22
Atrazine	1.39E-17	4.57E-16	1.00E-01	8.29E-25	2.72E-23
Benzaldehyde	1.23E-10	1.25E-10	1.00E-01	7.35E-18	7.46E-18
Benzofuran	2.37E-10	2.40E-10	1.00E-01	1.41E-17	1.43E-17
Benzoic Acid	5.98E-11	6.07E-11	1.00E-01	3.56E-18	3.61E-18
Benzonitrile	5.69E-14	5.77E-14	1.00E-01	3.39E-21	3.44E-21
Carbazole	1.14E-14	1.15E-14	1.00E-01	6.78E-22	6.87E-22
4-Chlorobiphenyl	6.88E-11	6.98E-11	1.00E-01	4.09E-18	4.15E-18
4,4-Chlorobiphenyl	9.01E-13	9.14E-13	1.00E-01	5.36E-20	5.44E-20
4-Chlorophenylmethylsulfone	4.58E-16	1.20E-14	1.00E-01	2.73E-23	7.15E-22
4-Chlorophenylmethylsulfoxide	1.70E-15	4.47E-14	1.00E-01	1.01E-22	2.66E-21
p,p-DDE	1.87E-12	9.39E-12	1.00E-01	1.11E-19	5.59E-19
p,p-DDT	3.75E-16	1.88E-15	1.00E-01	2.23E-23	1.12E-22
Dibenzofuran	1.18E-11	1.20E-11	1.00E-01	7.05E-19	7.15E-19
Dieldrin	1.24E-15	1.26E-15	1.00E-01	7.37E-23	7.47E-23
Diisopropyl Methylphosphonate	9.06E-15	1.59E-13	1.00E-01	5.39E-22	9.44E-21
1,3-Dimethylbenzene	2.37E-11	2.40E-11	1.00E-01	1.41E-18	1.43E-18
Dimethyl Methylphosphonate	3.57E-15	1.25E-13	1.00E-01	2.13E-22	7.44E-21
Dimethylphosphate	1.42E-12	1.44E-12	1.00E-01	8.46E-20	8.59E-20
Dioxins/Furans (EPA TEFs)	8.91E-13	3.47E-12	1.00E-01	5.31E-20	2.06E-19
Dithiane	2.17E-16	2.21E-16	1.00E-01	1.29E-23	1.31E-23
Endrin	2.49E-16	1.14E-15	1.00E-01	1.48E-23	6.77E-23
Hexachlorobenzene	5.05E-14	3.65E-13	1.00E-01	3.01E-21	2.17E-20
Hexachlorocyclopentadiene	1.12E-14	1.14E-14	1.00E-01	6.68E-22	6.77E-22
Isodrin	3.17E-15	3.22E-15	1.00E-01	1.89E-22	1.92E-22
Malathion	4.84E-15	4.91E-15	1.00E-01	2.88E-22	2.93E-22
Methanol	1.38E-10	1.40E-10	1.00E-01	8.19E-18	8.31E-18
4-Nitrophenol	5.01E-14	5.08E-14	1.00E-01	2.98E-21	3.03E-21
PAHs					
Acenaphthalene	5.93E-11	6.02E-11	1.00E-01	3.53E-18	3.58E-18
Acenaphthene	5.93E-11	6.02E-11	1.00E-01	3.53E-18	3.58E-18
Benzo(a)pyrene	2.09E-13	5.88E-12	1.00E-01	1.24E-20	3.50E-19
Chrysene	2.61E-13	6.67E-12	1.00E-01	1.56E-20	3.97E-19
Dibenzo(a,h)anthracene	2.84E-13	6.95E-12	1.00E-01	1.69E-20	4.14E-19
Fluoranthene	7.65E-13	1.98E-11	1.00E-01	4.56E-20	1.18E-18
Fluorene	1.18E-11	1.20E-11	1.00E-01	7.05E-19	7.15E-19
Phenanthrene	3.62E-13	1.08E-11	1.00E-01	2.16E-20	6.40E-19
Pyrene	1.76E-13	5.27E-12	1.00E-01	1.05E-20	3.14E-19
Parathion	6.68E-16	6.78E-16	1.00E-01	3.98E-23	4.04E-23
Pentachlorobenzene	1.81E-13	1.83E-13	1.00E-01	1.08E-20	1.09E-20
Phenol	6.42E-10	6.51E-10	1.00E-01	3.82E-17	3.88E-17
Quinoline	2.83E-14	2.87E-14	1.00E-01	1.69E-21	1.71E-21
Supona	2.01E-15	2.04E-15	1.00E-01	1.20E-22	1.21E-22
Tetrachlorobenzene	7.63E-14	7.74E-14	1.00E-01	4.54E-21	4.61E-21

Table 8F-1

(continued)

Trichlorobenzene	4.02E-14	4.08E-14	1.00E-01	2.39E-21	2.43E-21
Urea	8.69E-10	8.82E-10	1.00E-01	5.18E-17	5.25E-17
Vapona	5.35E-15	5.43E-15	1.00E-01	3.19E-22	3.23E-22
INORGANICS					
Antimony	5.52E-07	5.60E-07	1.00E-02	3.29E-15	3.33E-15
Arsenic	3.12E-06	3.17E-06	1.00E-02	1.86E-14	1.89E-14
Barium	7.65E-07	7.76E-07	1.00E-02	4.56E-15	4.62E-15
Beryllium	3.20E-08	3.24E-08	1.00E-02	1.90E-16	1.93E-16
Copper	2.93E-03	2.97E-03	1.00E-02	1.74E-11	1.77E-11
Lead	9.81E-07	9.95E-07	1.00E-02	5.84E-15	5.92E-15
Mercury	8.64E-07	8.77E-07	1.00E-02	5.15E-15	5.22E-15
Selenium	8.01E-03	8.13E-03	1.00E-02	4.77E-11	4.84E-11
Silver	8.30E-05	8.42E-05	1.00E-02	4.95E-13	5.02E-13
Thallium	8.06E-06	8.18E-06	1.00E-02	4.80E-14	4.87E-14

Number of exposure events per year (117 days/yr)
Exposed surface area (1,700 cm^2)
Skin adherence factor for soil (0.51 mg/cm^2)
Soil matrix factor (0.15)
Body weight (70 kg)

Table 8F-2

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure Adult, Resident-B Scenario

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	8.23E-13	8.34E-13	1.00E-01	4.90E-20	4.97E-20
Aldrin	8.72E-15	8.84E-15	1.00E-01	5.19E-22	5.27E-22
Atrazine	2.01E-17	6.60E-16	1.00E-01	1.20E-24	3.93E-23
Benzaldehyde	1.79E-10	1.81E-10	1.00E-01	1.06E-17	1.08E-17
Benzofuran	3.43E-10	3.48E-10	1.00E-01	2.04E-17	2.07E-17
Benzoic Acid	8.65E-11	8.77E-11	1.00E-01	5.15E-18	5.22E-18
Benzonitrile	8.23E-14	8.34E-14	1.00E-01	4.90E-21	4.97E-21
Carbazole	1.65E-14	1.67E-14	1.00E-01	9.80E-22	9.94E-22
4-Chlorobiphenyl	9.94E-11	1.01E-10	1.00E-01	5.92E-18	6.01E-18
4,4-Chlorobiphenyl	1.30E-12	1.32E-12	1.00E-01	7.75E-20	7.87E-20
4-Chlorophenylmethylsulfone	6.62E-16	1.74E-14	1.00E-01	3.94E-23	1.03E-21
4-Chlorophenylmethylsulfoxide	2.46E-15	6.46E-14	1.00E-01	1.47E-22	3.85E-21
p,p-DDE	2.70E-12	1.36E-11	1.00E-01	1.61E-19	8.09E-19
p,p-DDT	5.41E-16	2.72E-15	1.00E-01	3.22E-23	1.62E-22
Dibenzofuran	1.71E-11	1.74E-11	1.00E-01	1.02E-18	1.03E-18
Dieldrin	1.79E-15	1.81E-15	1.00E-01	1.07E-22	1.08E-22
Diisopropyl Methylphosphonate	1.31E-14	2.29E-13	1.00E-01	7.80E-22	1.36E-20
1,3-Dimethylbenzene	3.43E-11	3.48E-11	1.00E-01	2.04E-18	2.07E-18
Dimethyl Methylphosphonate	5.16E-15	1.81E-13	1.00E-01	3.07E-22	1.08E-20
Dimethylphosphate	2.05E-12	2.08E-12	1.00E-01	1.22E-19	1.24E-19
Dioxins/Furans (EPA TEFs)	1.29E-12	5.01E-12	1.00E-01	7.67E-20	2.98E-19
Dithiane	3.14E-16	3.19E-16	1.00E-01	1.87E-23	1.90E-23
Endrin	3.59E-16	1.64E-15	1.00E-01	2.14E-23	9.78E-23
Hexachlorobenzene	7.30E-14	5.28E-13	1.00E-01	4.35E-21	3.14E-20
Hexachlorocyclopentadiene	1.62E-14	1.64E-14	1.00E-01	9.65E-22	9.79E-22
Isodrin	4.59E-15	4.65E-15	1.00E-01	2.73E-22	2.77E-22
Malathion	7.00E-15	7.10E-15	1.00E-01	4.17E-22	4.23E-22
Methanol	1.99E-10	2.02E-10	1.00E-01	1.18E-17	1.20E-17
4-Nitrophenol	7.25E-14	7.35E-14	1.00E-01	4.31E-21	4.38E-21
PAHs					
Acenaphthalene	8.58E-11	8.70E-11	1.00E-01	5.11E-18	5.18E-18
Acenaphthene	8.58E-11	8.70E-11	1.00E-01	5.11E-18	5.18E-18
Benzo(a)pyrene	3.01E-13	8.50E-12	1.00E-01	1.80E-20	5.06E-19
Chrysene	3.78E-13	9.64E-12	1.00E-01	2.25E-20	5.74E-19
Dibenzo(a,h)anthracene	4.10E-13	1.01E-11	1.00E-01	2.44E-20	5.99E-19
Fluoranthene	1.11E-12	2.86E-11	1.00E-01	6.59E-20	1.70E-18
Fluorene	1.71E-11	1.74E-11	1.00E-01	1.02E-18	1.03E-18
Phenanthrene	5.24E-13	1.56E-11	1.00E-01	3.12E-20	9.26E-19
Pyrene	2.54E-13	7.61E-12	1.00E-01	1.51E-20	4.53E-19
Parathion	9.66E-16	9.80E-16	1.00E-01	5.75E-23	5.84E-23
Pentachlorobenzene	2.61E-13	2.65E-13	1.00E-01	1.56E-20	1.58E-20
Phenol	9.28E-10	9.41E-10	1.00E-01	5.52E-17	5.60E-17
Quinoline	4.10E-14	4.15E-14	1.00E-01	2.44E-21	2.47E-21
Supona	2.90E-15	2.94E-15	1.00E-01	1.73E-22	1.75E-22
Tetrachlorobenzene	1.10E-13	1.12E-13	1.00E-01	6.57E-21	6.66E-21

Table 8F-2

(continued)

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Trichlorobenzene	5.81E-14	5.89E-14	1.00E-01	3.46E-21	3.51E-21
Urea	1.26E-09	1.27E-09	1.00E-01	7.48E-17	7.59E-17
Vapona	7.74E-15	7.85E-15	1.00E-01	4.61E-22	4.67E-22
INORGANICS					
Antimony	7.98E-07	8.10E-07	1.00E-02	4.75E-15	4.82E-15
Arsenic	4.52E-06	4.58E-06	1.00E-02	2.69E-14	2.73E-14
Barium	1.11E-06	1.12E-06	1.00E-02	6.59E-15	6.68E-15
Beryllium	4.62E-08	4.69E-08	1.00E-02	2.75E-16	2.79E-16
Copper	4.24E-03	4.30E-03	1.00E-02	2.52E-11	2.56E-11
Lead	1.42E-06	1.44E-06	1.00E-02	8.44E-15	8.56E-15
Mercury	1.25E-06	1.27E-06	1.00E-02	7.44E-15	7.55E-15
Selenium	1.16E-02	1.18E-02	1.00E-02	6.90E-11	7.00E-11
Silver	1.20E-04	1.22E-04	1.00E-02	7.15E-13	7.25E-13
Thallium	1.17E-05	1.18E-05	1.00E-02	6.94E-14	7.04E-14

Number of exposure events per year (117 days/yr)
Exposed surface area (1,700 cm^2)
Skin adherence factor for soil (0.51 mg/cm^2)
Soil matrix factor (0.15)
Body weight (70 kg)

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Table 8F-3

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure Adult, Farmer Scenario

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	4.88E-13	4.95E-13	1.00E-01	3.32E-19	3.37E-19
Aldrin	5.17E-15	5.24E-15	1.00E-01	3.52E-21	3.57E-21
Atrazine	1.19E-17	3.92E-16	1.00E-01	8.13E-24	2.67E-22
Benzaldehyde	1.06E-10	1.07E-10	1.00E-01	7.21E-17	7.31E-17
Benzofuran	2.03E-10	2.06E-10	1.00E-01	1.38E-16	1.40E-16
Benzoic Acid	5.13E-11	5.20E-11	1.00E-01	3.49E-17	3.54E-17
Benzonitrile	4.88E-14	4.95E-14	1.00E-01	3.32E-20	3.37E-20
Carbazole	9.75E-15	9.89E-15	1.00E-01	6.64E-21	6.74E-21
4-Chlorobiphenyl	5.89E-11	5.98E-11	1.00E-01	4.01E-17	4.07E-17
4,4-Chlorobiphenyl	7.72E-13	7.83E-13	1.00E-01	5.26E-19	5.33E-19
4-Chlorophenylmethylsulfone	3.92E-16	1.03E-14	1.00E-01	2.67E-22	7.02E-21
4-Chlorophenylmethylsulfoxide	1.46E-15	3.83E-14	1.00E-01	9.95E-22	2.61E-20
p,p-DDE	1.60E-12	8.05E-12	1.00E-01	1.09E-18	5.48E-18
p,p-DDT	3.21E-16	1.61E-15	1.00E-01	2.19E-22	1.10E-21
Dibenzofuran	1.01E-11	1.03E-11	1.00E-01	6.91E-18	7.01E-18
Dieldrin	1.06E-15	1.08E-15	1.00E-01	7.22E-22	7.33E-22
Diisopropyl Methylphosphonate	7.76E-15	1.36E-13	1.00E-01	5.29E-21	9.25E-20
1,3-Dimethylbenzene	2.03E-11	2.06E-11	1.00E-01	1.38E-17	1.40E-17
Dimethyl Methylphosphonate	3.06E-15	1.07E-13	1.00E-01	2.08E-21	7.30E-20
Dimethylphosphate	1.22E-12	1.24E-12	1.00E-01	8.30E-19	8.42E-19
Dioxins/Furans (EPA TEFs)	7.64E-13	2.97E-12	1.00E-01	5.20E-19	2.02E-18
Dithiane	1.86E-16	1.89E-16	1.00E-01	1.27E-22	1.29E-22
Endrin	2.13E-16	9.73E-16	1.00E-01	1.45E-22	6.63E-22
Hexachlorobenzene	4.33E-14	3.13E-13	1.00E-01	2.95E-20	2.13E-19
Hexachlorocyclopentadiene	9.61E-15	9.75E-15	1.00E-01	6.54E-21	6.64E-21
Isodrin	2.72E-15	2.76E-15	1.00E-01	1.85E-21	1.88E-21
Malathion	4.15E-15	4.21E-15	1.00E-01	2.83E-21	2.87E-21
Methanol	1.18E-10	1.20E-10	1.00E-01	8.03E-17	8.15E-17
4-Nitrophenol	4.30E-14	4.36E-14	1.00E-01	2.93E-20	2.97E-20
PAHs					
Acenaphthalene	5.08E-11	5.16E-11	1.00E-01	3.46E-17	3.51E-17
Acenaphthene	5.08E-11	5.16E-11	1.00E-01	3.46E-17	3.51E-17
Benzo(a)pyrene	1.79E-13	5.04E-12	1.00E-01	1.22E-19	3.43E-18
Chrysene	2.24E-13	5.72E-12	1.00E-01	1.53E-19	3.90E-18
Dibenzo(a,h)anthracene	2.43E-13	5.96E-12	1.00E-01	1.66E-19	4.06E-18
Fluoranthene	6.56E-13	1.70E-11	1.00E-01	4.47E-19	1.16E-17
Fluorene	1.01E-11	1.03E-11	1.00E-01	6.91E-18	7.01E-18
Phenanthrene	3.10E-13	9.22E-12	1.00E-01	2.11E-19	6.28E-18
Pyrene	1.50E-13	4.51E-12	1.00E-01	1.02E-19	3.07E-18
Parathion	5.73E-16	5.81E-16	1.00E-01	3.90E-22	3.96E-22
Pentachlorobenzene	1.55E-13	1.57E-13	1.00E-01	1.06E-19	1.07E-19
Phenol	5.50E-10	5.58E-10	1.00E-01	3.75E-16	3.80E-16
Quinoline	2.43E-14	2.46E-14	1.00E-01	1.65E-20	1.68E-20
Supona	1.72E-15	1.75E-15	1.00E-01	1.17E-21	1.19E-21
Tetrachlorobenzene	6.54E-14	6.63E-14	1.00E-01	4.45E-20	4.52E-20

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Table 8F-3

(continued)

Trichlorobenzene	3.44E-14	3.49E-14	1.00E-01	2.35E-20	2.38E-20
Urea	7.45E-10	7.56E-10	1.00E-01	5.07E-16	5.15E-16
Vapona	4.59E-15	4.65E-15	1.00E-01	3.12E-21	3.17E-21
INORGANICS					
Antimony	4.73E-07	4.80E-07	1.00E-02	3.22E-14	3.27E-14
Arsenic	2.68E-06	2.72E-06	1.00E-02	1.82E-13	1.85E-13
Barium	6.56E-07	6.65E-07	1.00E-02	4.47E-14	4.53E-14
Beryllium	2.74E-08	2.78E-08	1.00E-02	1.87E-15	1.89E-15
Copper	2.51E-03	2.55E-03	1.00E-02	1.71E-10	1.74E-10
Lead	8.40E-07	8.53E-07	1.00E-02	5.72E-14	5.81E-14
Mercury	7.41E-07	7.52E-07	1.00E-02	5.05E-14	5.12E-14
Selenium	6.87E-03	6.97E-03	1.00E-02	4.68E-10	4.75E-10
Silver	7.12E-05	7.22E-05	1.00E-02	4.85E-12	4.92E-12
Thallium	6.91E-06	7.01E-06	1.00E-02	4.71E-13	4.78E-13

Number of exposure events per year (195 days/yr)
Exposed surface area (1,700 cm^2)
Skin adherence factor for soil (3.5 mg/cm^2)
Soil matrix factor (0.15)
Body weight (70 kg)

Table 8F-4

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure
Adult, Worker Scenario

	AVERAGE CALCULATED CONC IN SOIL .2M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .2M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	7.46E-13	7.57E-13	1.00E-01	5.08E-19	5.16E-19
Aldrin	7.91E-15	8.02E-15	1.00E-01	5.39E-21	5.46E-21
Atrazine	1.83E-17	5.99E-16	1.00E-01	1.24E-23	4.08E-22
Benzaldehyde	1.62E-10	1.64E-10	1.00E-01	1.10E-16	1.12E-16
Benzofuran	3.11E-10	3.15E-10	1.00E-01	2.12E-16	2.15E-16
Benzoic Acid	7.84E-11	7.96E-11	1.00E-01	5.34E-17	5.42E-17
Benzonitrile	7.46E-14	7.57E-14	1.00E-01	5.08E-20	5.16E-20
Carbazole	1.49E-14	1.51E-14	1.00E-01	1.02E-20	1.03E-20
4-Chlorobiphenyl	9.02E-11	9.15E-11	1.00E-01	6.14E-17	6.23E-17
4,4-Chlorobiphenyl	1.18E-12	1.20E-12	1.00E-01	8.05E-19	8.16E-19
4-Chlorophenylmethylsulfone	6.00E-16	1.57E-14	1.00E-01	4.09E-22	1.07E-20
4-Chlorophenylmethylsulfoxide	2.23E-15	5.86E-14	1.00E-01	1.52E-21	3.99E-20
p,p-DDE	2.45E-12	1.23E-11	1.00E-01	1.67E-18	8.39E-18
p,p-DDT	4.91E-16	2.47E-15	1.00E-01	3.35E-22	1.68E-21
Dibenzofuran	1.55E-11	1.58E-11	1.00E-01	1.06E-17	1.07E-17
Dieldrin	1.62E-15	1.65E-15	1.00E-01	1.11E-21	1.12E-21
Diisopropyl Methylphosphonate	1.19E-14	2.08E-13	1.00E-01	8.09E-21	1.42E-19
1,3-Dimethylbenzene	3.11E-11	3.15E-11	1.00E-01	2.12E-17	2.15E-17
Dimethyl Methylphosphonate	4.68E-15	1.64E-13	1.00E-01	3.19E-21	1.12E-19
Dimethylphosphate	1.86E-12	1.89E-12	1.00E-01	1.27E-18	1.29E-18
Dioxins/Furans (EPA TEFs)	1.17E-12	4.55E-12	1.00E-01	7.96E-19	3.10E-18
Dithiane	2.85E-16	2.89E-16	1.00E-01	1.94E-22	1.97E-22
Endrin	3.26E-16	1.49E-15	1.00E-01	2.22E-22	1.01E-21
Hexachlorobenzene	6.62E-14	4.79E-13	1.00E-01	4.51E-20	3.26E-19
Hexachlorocyclopentadiene	1.47E-14	1.49E-14	1.00E-01	1.00E-20	1.02E-20
Isodrin	4.16E-15	4.22E-15	1.00E-01	2.83E-21	2.87E-21
Malathion	6.35E-15	6.44E-15	1.00E-01	4.33E-21	4.39E-21
Methanol	1.80E-10	1.83E-10	1.00E-01	1.23E-16	1.25E-16
4-Nitrophenol	6.57E-14	6.67E-14	1.00E-01	4.48E-20	4.54E-20
PAHs					
Acenaphthalene	7.78E-11	7.89E-11	1.00E-01	5.30E-17	5.38E-17
Acenaphthene	7.78E-11	7.89E-11	1.00E-01	5.30E-17	5.38E-17
Benzo(a)pyrene	2.74E-13	7.71E-12	1.00E-01	1.86E-19	5.25E-18
Chrysene	3.43E-13	8.75E-12	1.00E-01	2.34E-19	5.96E-18
Dibenzo(a,h)anthracene	3.72E-13	9.12E-12	1.00E-01	2.53E-19	6.21E-18
Fluoranthene	1.00E-12	2.59E-11	1.00E-01	6.83E-19	1.77E-17
Fluorene	1.55E-11	1.58E-11	1.00E-01	1.06E-17	1.07E-17
Phenanthrene	4.75E-13	1.41E-11	1.00E-01	3.23E-19	9.61E-18
Pyrene	2.30E-13	6.91E-12	1.00E-01	1.57E-19	4.70E-18
Parathion	8.76E-16	8.89E-16	1.00E-01	5.97E-22	6.06E-22
Pentachlorobenzene	2.37E-13	2.41E-13	1.00E-01	1.62E-19	1.64E-19
Phenol	8.41E-10	8.54E-10	1.00E-01	5.73E-16	5.81E-16
Quinoline	3.71E-14	3.77E-14	1.00E-01	2.53E-20	2.57E-20
Supona	2.63E-15	2.67E-15	1.00E-01	1.79E-21	1.82E-21
Tetrachlorobenzene	1.00E-13	1.01E-13	1.00E-01	6.81E-20	6.91E-20

Table 8F-4

(continued)

Trichlorobenzene	5.27E-14	5.35E-14	1.00E-01	3.59E-20	3.64E-20
Urea	1.14E-09	1.16E-09	1.00E-01	7.76E-16	7.88E-16
Vapona	7.02E-15	7.12E-15	1.00E-01	4.78E-21	4.85E-21
INORGANICS					
Antimony	7.24E-07	7.34E-07	1.00E-02	4.93E-14	5.00E-14
Arsenic	4.10E-06	4.16E-06	1.00E-02	2.79E-13	2.83E-13
Barium	1.00E-06	1.02E-06	1.00E-02	6.83E-14	6.93E-14
Beryllium	4.19E-08	4.25E-08	1.00E-02	2.85E-15	2.90E-15
Copper	3.84E-03	3.90E-03	1.00E-02	2.62E-10	2.65E-10
Lead	1.29E-06	1.30E-06	1.00E-02	8.76E-14	8.89E-14
Mercury	1.13E-06	1.15E-06	1.00E-02	7.72E-14	7.83E-14
Selenium	1.05E-02	1.07E-02	1.00E-02	7.16E-10	7.26E-10
Silver	1.09E-04	1.10E-04	1.00E-02	7.42E-12	7.53E-12
Thallium	1.06E-05	1.07E-05	1.00E-02	7.20E-13	7.31E-13

Number of exposure events per year (195 days/yr)
Exposed surface area (1,700 cm^2)
Skin adherence factor for soil (3.5 mg/cm^2)
Soil matrix factor (0.15)
Body weight (70 kg)

Table 8F-5

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure Child, Resident-A Scenario

	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	1.14E-12	1.15E-12	1.00E-01	6.56E-19	6.66E-19
Aldrin	1.21E-14	1.22E-14	1.00E-01	6.96E-21	7.06E-21
Atrazine	2.78E-17	9.14E-16	1.00E-01	1.61E-23	5.27E-22
Benzaldehyde	2.47E-10	2.51E-10	1.00E-01	1.42E-16	1.45E-16
Benzofuran	4.74E-10	4.81E-10	1.00E-01	2.73E-16	2.77E-16
Benzoic Acid	1.20E-10	1.21E-10	1.00E-01	6.90E-17	7.00E-17
Benzonitrile	1.14E-13	1.15E-13	1.00E-01	6.56E-20	6.66E-20
Carbazole	2.28E-14	2.31E-14	1.00E-01	1.31E-20	1.33E-20
4-Chlorobiphenyl	1.38E-10	1.40E-10	1.00E-01	7.93E-17	8.05E-17
4,4-Chlorobiphenyl	1.80E-12	1.83E-12	1.00E-01	1.04E-18	1.05E-18
4-Chlorophenylmethylsulfone	9.15E-16	2.40E-14	1.00E-01	5.28E-22	1.39E-20
4-Chlorophenylmethylsulfoxide	3.41E-15	8.94E-14	1.00E-01	1.97E-21	5.16E-20
p,p-DDE	3.74E-12	1.88E-11	1.00E-01	2.16E-18	1.08E-17
p,p-DDT	7.49E-16	3.76E-15	1.00E-01	4.32E-22	2.17E-21
Dibenzofuran	2.37E-11	2.40E-11	1.00E-01	1.37E-17	1.39E-17
Dieldrin	2.47E-15	2.51E-15	1.00E-01	1.43E-21	1.45E-21
Diisopropyl Methylphosphonate	1.81E-14	3.17E-13	1.00E-01	1.04E-20	1.83E-19
1,3-Dimethylbenzene	4.74E-11	4.81E-11	1.00E-01	2.73E-17	2.77E-17
Dimethyl Methylphosphonate	7.14E-15	2.50E-13	1.00E-01	4.12E-21	1.44E-19
Dimethylphosphate	2.84E-12	2.88E-12	1.00E-01	1.64E-18	1.66E-18
Dioxins/Furans (EPA TEFs)	1.78E-12	6.93E-12	1.00E-01	1.03E-18	4.00E-18
Dithiane	4.35E-16	4.41E-16	1.00E-01	2.51E-22	2.54E-22
Endrin	4.97E-16	2.27E-15	1.00E-01	2.87E-22	1.31E-21
Hexachlorobenzene	1.01E-13	7.30E-13	1.00E-01	5.83E-20	4.21E-19
Hexachlorocyclopentadiene	2.24E-14	2.27E-14	1.00E-01	1.29E-20	1.31E-20
Isodrin	6.34E-15	6.44E-15	1.00E-01	3.66E-21	3.71E-21
Malathion	9.68E-15	9.82E-15	1.00E-01	5.59E-21	5.67E-21
Methanol	2.75E-10	2.79E-10	1.00E-01	1.59E-16	1.61E-16
4-Nitrophenol	1.00E-13	1.02E-13	1.00E-01	5.78E-20	5.87E-20
PAHs					
Acenaphthalene	1.19E-10	1.20E-10	1.00E-01	6.84E-17	6.94E-17
Acenaphthene	1.19E-10	1.20E-10	1.00E-01	6.84E-17	6.94E-17
Benzo(a)pyrene	4.17E-13	1.18E-11	1.00E-01	2.41E-19	6.79E-18
Chrysene	5.23E-13	1.33E-11	1.00E-01	3.02E-19	7.70E-18
Dibenzo(a,h)anthracene	5.67E-13	1.39E-11	1.00E-01	3.27E-19	8.03E-18
Fluoranthene	1.53E-12	3.96E-11	1.00E-01	8.83E-19	2.28E-17
Fluorene	2.37E-11	2.40E-11	1.00E-01	1.37E-17	1.39E-17
Phenanthrene	7.24E-13	2.15E-11	1.00E-01	4.18E-19	1.24E-17
Pyrene	3.51E-13	1.05E-11	1.00E-01	2.03E-19	6.08E-18
Parathion	1.34E-15	1.36E-15	1.00E-01	7.71E-22	7.82E-22
Pentachlorobenzene	3.62E-13	3.67E-13	1.00E-01	2.09E-19	2.12E-19
Phenol	1.28E-09	1.30E-09	1.00E-01	7.40E-16	7.51E-16
Quinoline	5.67E-14	5.75E-14	1.00E-01	3.27E-20	3.32E-20
Supona	4.01E-15	4.07E-15	1.00E-01	2.32E-21	2.35E-21
Tetrachlorobenzene	1.53E-13	1.55E-13	1.00E-01	8.80E-20	8.93E-20

Table 8F-5

(continued)

Trichlorobenzene	8.04E-14	8.15E-14	1.00E-01	4.64E-20	4.70E-20
Urea	1.74E-09	1.76E-09	1.00E-01	1.00E-15	1.02E-15
Vapona	1.07E-14	1.09E-14	1.00E-01	6.17E-21	6.26E-21
INORGANICS					
Antimony	1.10E-06	1.12E-06	1.00E-02	6.37E-14	6.46E-14
Arsenic	6.25E-06	6.34E-06	1.00E-02	3.60E-13	3.66E-13
Barium	1.53E-06	1.55E-06	1.00E-02	8.83E-14	8.96E-14
Beryllium	6.39E-08	6.48E-08	1.00E-02	3.69E-15	3.74E-15
Copper	5.86E-03	5.94E-03	1.00E-02	3.38E-10	3.43E-10
Lead	1.96E-06	1.99E-06	1.00E-02	1.13E-13	1.15E-13
Mercury	1.73E-06	1.75E-06	1.00E-02	9.97E-14	1.01E-13
Selenium	1.60E-02	1.63E-02	1.00E-02	9.25E-10	9.38E-10
Silver	1.66E-04	1.68E-04	1.00E-02	9.58E-12	9.72E-12
Thallium	1.61E-05	1.64E-05	1.00E-02	9.30E-13	9.44E-13

Number of exposure events per year (195 days/yr)
Exposed surface area (2,188 cm^2)
Skin adherence factor for soil (0.51 mg/cm^2)
Soil matrix factor (0.15)
Body weight (15.5 kg)

Table 8F-6

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure Child, Resident-B Scenario

	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	1.65E-12	1.67E-12	1.00E-01	9.49E-19	9.63E-19
Aldrin	1.74E-14	1.77E-14	1.00E-01	1.01E-20	1.02E-20
Atrazine	4.03E-17	1.32E-15	1.00E-01	2.32E-23	7.62E-22
Benzaldehyde	3.57E-10	3.62E-10	1.00E-01	2.06E-16	2.09E-16
Benzofuran	6.85E-10	6.95E-10	1.00E-01	3.95E-16	4.01E-16
Benzoic Acid	1.73E-10	1.75E-10	1.00E-01	9.98E-17	1.01E-16
Benzonitrile	1.65E-13	1.67E-13	1.00E-01	9.49E-20	9.63E-20
Carbazole	3.29E-14	3.34E-14	1.00E-01	1.90E-20	1.93E-20
4-Chlorobiphenyl	1.99E-10	2.02E-10	1.00E-01	1.15E-16	1.16E-16
4,4-Chlorobiphenyl	2.60E-12	2.64E-12	1.00E-01	1.50E-18	1.52E-18
4-Chlorophenylmethylsulfone	1.32E-15	3.47E-14	1.00E-01	7.63E-22	2.00E-20
4-Chlorophenylmethylsulfoxide	4.92E-15	1.29E-13	1.00E-01	2.84E-21	7.46E-20
p,p-DDE	5.41E-12	2.72E-11	1.00E-01	3.12E-18	1.57E-17
p,p-DDT	1.08E-15	5.44E-15	1.00E-01	6.25E-22	3.14E-21
Dibenzofuran	3.42E-11	3.47E-11	1.00E-01	1.97E-17	2.00E-17
Dieldrin	3.58E-15	3.63E-15	1.00E-01	2.06E-21	2.09E-21
Diisopropyl Methylphosphonate	2.62E-14	4.58E-13	1.00E-01	1.51E-20	2.64E-19
1,3-Dimethylbenzene	6.85E-11	6.95E-11	1.00E-01	3.95E-17	4.01E-17
Dimethyl Methylphosphonate	1.03E-14	3.61E-13	1.00E-01	5.95E-21	2.08E-19
Dimethylphosphate	4.11E-12	4.17E-12	1.00E-01	2.37E-18	2.41E-18
Dioxins/Furans (EPA TEFs)	2.58E-12	1.00E-11	1.00E-01	1.49E-18	5.78E-18
Dithiane	6.29E-16	6.38E-16	1.00E-01	3.63E-22	3.68E-22
Endrin	7.19E-16	3.28E-15	1.00E-01	4.15E-22	1.89E-21
Hexachlorobenzene	1.46E-13	1.06E-12	1.00E-01	8.43E-20	6.09E-19
Hexachlorocyclopentadiene	3.24E-14	3.29E-14	1.00E-01	1.87E-20	1.90E-20
Isodrin	9.17E-15	9.30E-15	1.00E-01	5.29E-21	5.37E-21
Malathion	1.40E-14	1.42E-14	1.00E-01	8.08E-21	8.19E-21
Methanol	3.98E-10	4.03E-10	1.00E-01	2.29E-16	2.33E-16
4-Nitrophenol	1.45E-13	1.47E-13	1.00E-01	8.36E-20	8.48E-20
PAHs					
Acenaphthalene	1.72E-10	1.74E-10	1.00E-01	9.89E-17	1.00E-16
Acenaphthene	1.72E-10	1.74E-10	1.00E-01	9.89E-17	1.00E-16
Benzo(a)pyrene	6.03E-13	1.70E-11	1.00E-01	3.48E-19	9.81E-18
Chrysene	7.55E-13	1.93E-11	1.00E-01	4.36E-19	1.11E-17
Dibenzo(a,h)anthracene	8.20E-13	2.01E-11	1.00E-01	4.73E-19	1.16E-17
Fluoranthene	2.21E-12	5.72E-11	1.00E-01	1.28E-18	3.30E-17
Fluorene	3.42E-11	3.47E-11	1.00E-01	1.97E-17	2.00E-17
Phenanthrene	1.05E-12	3.11E-11	1.00E-01	6.04E-19	1.79E-17
Pyrene	5.07E-13	1.52E-11	1.00E-01	2.93E-19	8.78E-18
Parathion	1.93E-15	1.96E-15	1.00E-01	1.11E-21	1.13E-21
Pentachlorobenzene	5.23E-13	5.31E-13	1.00E-01	3.02E-19	3.06E-19
Phenol	1.86E-09	1.88E-09	1.00E-01	1.07E-15	1.09E-15
Quinoline	8.19E-14	8.31E-14	1.00E-01	4.73E-20	4.79E-20
Supona	5.80E-15	5.89E-15	1.00E-01	3.35E-21	3.40E-21
Tetrachlorobenzene	2.21E-13	2.24E-13	1.00E-01	1.27E-19	1.29E-19

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Table 8F-6

(continued)

Trichlorobenzene	1.16E-13	1.18E-13	1.00E-01	6.70E-20	6.80E-20
Urea	2.51E-09	2.55E-09	1.00E-01	1.45E-15	1.47E-15
Vapona	1.55E-14	1.57E-14	1.00E-01	8.93E-21	9.05E-21
INORGANICS					
Antimony	1.60E-06	1.62E-06	1.00E-02	9.21E-14	9.34E-14
Arsenic	9.03E-06	9.16E-06	1.00E-02	5.21E-13	5.29E-13
Barium	2.21E-06	2.24E-06	1.00E-02	1.28E-13	1.29E-13
Beryllium	9.24E-08	9.37E-08	1.00E-02	5.33E-15	5.41E-15
Copper	8.47E-03	8.59E-03	1.00E-02	4.89E-10	4.96E-10
Lead	2.84E-06	2.88E-06	1.00E-02	1.64E-13	1.66E-13
Mercury	2.50E-06	2.54E-06	1.00E-02	1.44E-13	1.46E-13
Selenium	2.32E-02	2.35E-02	1.00E-02	1.34E-09	1.36E-09
Silver	2.40E-04	2.44E-04	1.00E-02	1.39E-11	1.41E-11
Thallium	2.33E-05	2.36E-05	1.00E-02	1.34E-12	1.36E-12

Number of exposure events per year (195 days/yr)
Exposed surface area (2,188 cm^2)
Skin adherence factor for soil (0.51 mg/cm^2)
Soil matrix factor (0.15)
Body weight (15.5 kg)

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Table 8F-7

Average and Maximum Daily Exposure to the Pollutants of Concern Through the Dermal Absorption Route of Exposure Child, Farmer Scenario

	AVERAGE CALCULATED CONC IN SOIL .1M mg/Kg	MAXIMUM CALCULATED CONC IN SOIL .1M mg/Kg	ABSORPTION FACTOR	AVERAGE ESTIMATED DAILY INTAKE mg/Kg/day	MAXIMUM ESTIMATED DAILY INTAKE mg/Kg/day
ORGANICS					
Acetonitrile	9.75E-13	9.89E-13	1.00E-01	5.63E-19	5.71E-19
Aldrin	1.03E-14	1.05E-14	1.00E-01	5.96E-21	6.05E-21
Atrazine	2.39E-17	7.83E-16	1.00E-01	1.38E-23	4.52E-22
Benzaldehyde	2.12E-10	2.15E-10	1.00E-01	1.22E-16	1.24E-16
Benzofuran	4.06E-10	4.12E-10	1.00E-01	2.34E-16	2.38E-16
Benzoic Acid	1.03E-10	1.04E-10	1.00E-01	5.91E-17	6.00E-17
Benzonitrile	9.75E-14	9.89E-14	1.00E-01	5.63E-20	5.71E-20
Carbazole	1.95E-14	1.98E-14	1.00E-01	1.13E-20	1.14E-20
4-Chlorobiphenyl	1.18E-10	1.20E-10	1.00E-01	6.80E-17	6.90E-17
4,4-Chlorobiphenyl	1.54E-12	1.57E-12	1.00E-01	8.91E-19	9.04E-19
4-Chlorophenylmethylsulfone	7.84E-16	2.06E-14	1.00E-01	4.53E-22	1.19E-20
4-Chlorophenylmethylsulfoxide	2.92E-15	7.66E-14	1.00E-01	1.68E-21	4.42E-20
p,p-DDE	3.21E-12	1.61E-11	1.00E-01	1.85E-18	9.29E-18
p,p-DDT	6.42E-16	3.22E-15	1.00E-01	3.70E-22	1.86E-21
Dibenzofuran	2.03E-11	2.06E-11	1.00E-01	1.17E-17	1.19E-17
Dieldrin	2.12E-15	2.15E-15	1.00E-01	1.22E-21	1.24E-21
Diisopropyl Methylphosphonate	1.55E-14	2.72E-13	1.00E-01	8.95E-21	1.57E-19
1,3-Dimethylbenzene	4.06E-11	4.12E-11	1.00E-01	2.34E-17	2.38E-17
Dimethyl Methylphosphonate	6.12E-15	2.14E-13	1.00E-01	3.53E-21	1.24E-19
Dimethylphosphate	2.44E-12	2.47E-12	1.00E-01	1.41E-18	1.43E-18
Dioxins/Furans (EPA TEFs)	1.53E-12	5.94E-12	1.00E-01	8.81E-19	3.43E-18
Dithiane	3.73E-16	3.78E-16	1.00E-01	2.15E-22	2.18E-22
Endrin	4.26E-16	1.95E-15	1.00E-01	2.46E-22	1.12E-21
Hexachlorobenzene	8.66E-14	6.26E-13	1.00E-01	5.00E-20	3.61E-19
Hexachlorocyclopentadiene	1.92E-14	1.95E-14	1.00E-01	1.11E-20	1.12E-20
Isodrin	5.44E-15	5.52E-15	1.00E-01	3.14E-21	3.18E-21
Malathion	8.30E-15	8.42E-15	1.00E-01	4.79E-21	4.86E-21
Methanol	2.36E-10	2.39E-10	1.00E-01	1.36E-16	1.38E-16
4-Nitrophenol	8.59E-14	8.72E-14	1.00E-01	4.96E-20	5.03E-20
PAHs					
Acenaphthalene	1.02E-10	1.03E-10	1.00E-01	5.87E-17	5.95E-17
Acenaphthene	1.02E-10	1.03E-10	1.00E-01	5.87E-17	5.95E-17
Benzo(a)pyrene	3.58E-13	1.01E-11	1.00E-01	2.06E-19	5.82E-18
Chrysene	4.48E-13	1.14E-11	1.00E-01	2.58E-19	6.60E-18
Dibenzo(a,h)anthracene	4.86E-13	1.19E-11	1.00E-01	2.81E-19	6.88E-18
Fluoranthene	1.31E-12	3.39E-11	1.00E-01	7.57E-19	1.96E-17
Fluorene	2.03E-11	2.06E-11	1.00E-01	1.17E-17	1.19E-17
Phenanthrene	6.21E-13	1.84E-11	1.00E-01	3.58E-19	1.06E-17
Pyrene	3.01E-13	9.02E-12	1.00E-01	1.74E-19	5.21E-18
Parathion	1.15E-15	1.16E-15	1.00E-01	6.61E-22	6.70E-22
Pentachlorobenzene	3.10E-13	3.15E-13	1.00E-01	1.79E-19	1.81E-19
Phenol	1.10E-09	1.12E-09	1.00E-01	6.35E-16	6.44E-16
Quinoline	4.86E-14	4.93E-14	1.00E-01	2.80E-20	2.84E-20
Supona	3.44E-15	3.49E-15	1.00E-01	1.99E-21	2.01E-21
Tetrachlorobenzene	1.31E-13	1.33E-13	1.00E-01	7.54E-20	7.65E-20

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Table 8F-7

(continued)

Trichlorobenzene	6.89E-14	6.99E-14	1.00E-01	3.97E-20	4.03E-20
Urea	1.49E-09	1.51E-09	1.00E-01	8.60E-16	8.72E-16
Vapona	9.17E-15	9.31E-15	1.00E-01	5.29E-21	5.37E-21
INORGANICS					
Antimony	9.46E-07	9.60E-07	1.00E-02	5.46E-14	5.54E-14
Arsenic	5.35E-06	5.43E-06	1.00E-02	3.09E-13	3.13E-13
Barium	1.31E-06	1.33E-06	1.00E-02	7.57E-14	7.68E-14
Beryllium	5.48E-08	5.56E-08	1.00E-02	3.16E-15	3.21E-15
Copper	5.02E-03	5.09E-03	1.00E-02	2.90E-10	2.94E-10
Lead	1.68E-06	1.71E-06	1.00E-02	9.70E-14	9.84E-14
Mercury	1.48E-06	1.50E-06	1.00E-02	8.55E-14	8.67E-14
Selenium	1.37E-02	1.39E-02	1.00E-02	7.93E-10	8.04E-10
Silver	1.42E-04	1.44E-04	1.00E-02	8.21E-12	8.33E-12
Thallium	1.38E-05	1.40E-05	1.00E-02	7.97E-13	8.09E-13

Number of exposure events per year (195 days/yr)
Exposed surface area (2,188 cm^2)
Skin adherence factor for soil (0.51 mg/cm^2)
Soil matrix factor (0.15)
Body weight (15.5 kg)

APPENDIX 8G

METHODOLOGY FOR CALCULATING ORGANIC POLLUTANT CONCENTRATIONS IN MOTHER'S MILK

APPENDIX 8G

METHODOLOGY FOR CALCULATING ORGANIC POLLUTANT CONCENTRATIONS IN MOTHER'S MILK

This appendix presents a discussion of the methods used to determine the organic pollutant concentrations in mother's milk. These concentrations are used in the calculation of the daily intakes of pollutants by infants through the consumption of mother's (i.e., breast) milk.

The concentration of dioxins in breast milk was calculated using the following equation that was developed for dioxins (Smith, 1987):

$$C_{DBM} = \frac{TEDI \times f_1 \times f_2}{f_3 \times k}$$

Where:

C_{DBM} = Concentration of dioxins in breast milk (mg/kg).

TEDI = Total Estimated Daily Intake, the maximum daily intake of dioxins by the mother through all potential exposure routes (mg/kg/day).

f_1 = Proportion of dioxins stored in body fat (unitless).

f_2 = Proportion of breast milk that is fat (unitless).

f_3 = Proportion of body weight that is fat (unitless).

k = Rate constant ($days^{-1}$).

The maximum total estimated daily intake of the mother was used to estimate breast milk concentrations for dioxins as well as all other organics.

Values of 0.8, 0.04, and 0.3 were used for f_1, f_2, and f_3, respectively (Smith, 1987). A rate constant of 3.27E-04 days^{-1} was calculated as follows. Assuming a half-life ($t_{1/2}$) of dioxins in the human body of 2,120 days (ATSDR, 1989a):

$$k' = \frac{\ln 2}{t_{1/2}}$$

The equation developed by Smith (1987) was applied to the other organic pollutants of concern using available information. Data were available on the half-lives of ten organics (in addition to dioxin) in humans and mammals. A half-life of 8 hours was used for acrylonitrile; the half-life of acrylonitrile in humans is reported to range from 7 to 8 hours (ATSDR, 1989b). A half-life of 3 hours was used for benzene; the half-life of benzene in humans is reported to range from 1 to 3 hours (Baselt, 1982). Half-lives in humans of 240 days and 120 days were used for DDE and DDT, respectively. These values are based on half-lives in rats of 24 days and 12 days for DDE and DDT, respectively (ATSDR, 1988a). An uncertainty factor of 10 was applied to the 24 and 12 day half-lives to account for the absence of human data. A half-life in humans of 45 hours was used for 1,1-dichloroethene and phenol. This value is based on a half-life in rats (1,1-dichloroethene) and an unreported species (phenol) of 4.5 hours (ATSDR, 1988b; Baselt, 1982). An uncertainty factor of 10 was applied to the half-life of 4.5 hours to account for the absence of human data. A half-life of 266 days in humans was used for dieldrin (ATSDR, 1989c). A half-life of 60 days has been reported for hexachlorobenzene in humans (Baselt, 1982). This half-life also was assumed for all other semi-volatile chlorinated benzenes (i.e., trichlorobenzene, tetrachlorobenzene, and pentachlorobenzene). A half-life of 7.5 hours in humans was used for toluene (Baselt, 1982), whereas a half-life of 1.5 hours in humans was used for xylene (Baselt, 1982). For those semi-volatile organics, for which half-life data in humans or mammals were not available, the half-life of dieldrin (266 days) was used. The half-life of dieldrin is the longest half-life available for the semi-volatile, other than dioxin. Since there are few organics that would accumulate in breast milk to the extent of dioxin, it would be overly conservative to apply the half-life for dioxins in humans to all semi-volatile organics.

Thus, the next highest half-life (i.e., dieldrin) was used. The half-life for 1,1-dichloroethene of 45 hours in humans was applied to all volatile organics (as defined in Subsection 7.4.2) for which half-life data were not available. This is the longest half-life that is assumed for the volatile organics, which are being evaluated.

From the available or calculated half-lives, the following rate constants (k) were calculated: acrylonitrile (2.08E+00 day^{-1}); benzene (5.54E+00 day^{-1}); DDE (2.89E-03 day^{-1}); DDT (5.77E-03 day^{-1}); 1,1-dichloroethene, phenol, and those volatile organics for which insufficient half-life data were available (3.70E-01 day^{-1}); dieldrin, and those semi-volatile organics for which insufficient half-life data were available (2.61E-03 day^{-1}); trichlorobenzene, tetrachlorobenzene, pentachlorobenzene, and hexachlorobenzene (1.15E-02 day^{-1}); toluene (2.22E+00); and xylene (1.11E+01 day^{-1}). The proportion of these organics stored in body fat (f_1) was assumed to be the same as that of dioxin (0.8).

Tables 8G-1 through 8G-3 present pollutant concentrations in breast milk for the Resident-A, Resident-B, and Farmer scenarios, respectively.

Table 8G-1

Pollutant Concentrations in Breast Milk, Resident-A Scenario

	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
ORGANICS				
Acetone	5.04E-17	2.89E-01	1.46E-17	1.29E-18
Acetonitrile	5.94E-15	4.09E+01	2.43E-13	2.16E-14
Acrylonitrile	3.06E-16	5.13E-02	1.57E-17	1.40E-18
Aldrin	4.28E-17	4.09E+01	1.75E-15	1.56E-16
Atrazine	7.45E-18	4.09E+01	3.05E-16	2.71E-17
Benzaldehyde	7.14E-13	4.09E+01	2.92E-11	2.60E-12
Benzene	6.55E-13	1.92E-02	1.26E-14	1.12E-15
Benzofuran	1.34E-12	4.09E+01	5.49E-11	4.88E-12
Benzoic Acid	3.40E-13	4.09E+01	1.39E-11	1.24E-12
Benzonitrile	3.28E-16	4.09E+01	1.34E-14	1.19E-15
Biphenyl	3.19E-13	4.09E+01	1.31E-11	1.16E-12
Bromomethane	6.38E-14	2.89E-01	1.84E-14	1.64E-15
Carbazole	6.38E-17	4.09E+01	2.61E-15	2.32E-16
Carbon Tetrachloride	2.03E-16	2.89E-01	5.87E-17	5.21E-18
Chlorobenzene	1.58E-13	2.89E-01	4.55E-14	4.04E-15
4-Chlorobiphenyl	3.82E-13	4.09E+01	1.57E-11	1.39E-12
4,4-Chlorobiphenyl	5.01E-15	4.09E+01	2.05E-13	1.82E-14
Chloroform	3.22E-17	2.89E-01	9.29E-18	8.26E-19
4-Chlorophenylmethylsulfone	1.26E-16	4.09E+01	5.14E-15	4.57E-16
4-Chlorophenylmethylsulfoxide	4.66E-16	4.09E+01	1.91E-14	1.70E-15
p,p-DDE	5.61E-14	3.69E+01	2.07E-12	1.84E-13
p,p-DDT	1.14E-17	1.85E+01	2.11E-16	1.88E-17
Dibenzofuran	6.60E-14	4.09E+01	2.70E-12	2.40E-13
Dichlorobenzenes (total)	1.15E-16	2.89E-01	3.31E-17	2.94E-18
1,4-Dichlorobenzene	7.25E-18	2.89E-01	2.09E-18	1.86E-19
1,1-Dichloroethene	1.78E-16	2.89E-01	5.15E-17	4.58E-18
1,2-Dichloroethene	1.24E-16	2.89E-01	3.58E-17	3.19E-18
1,2-Dichloropropane	1.45E-17	2.89E-01	4.17E-18	3.71E-19
Dieldrin	1.59E-17	4.09E+01	6.52E-16	5.80E-17
Diisopropyl Methylphosphonate	1.23E-15	4.09E+01	5.04E-14	4.48E-15
1,3-Dimethylbenzene	1.33E-13	4.09E+01	5.45E-12	4.84E-13
Dimethyldisulfide	3.24E-15	4.09E+01	1.33E-13	1.18E-14
Dimethyl Methylphosphonate	3.11E-14	4.09E+01	1.27E-12	1.13E-13
Dimethylphosphate	7.85E-15	4.09E+01	3.21E-13	2.86E-14
Dioxins/Furans (EPA TEFs)	2.02E-14	3.26E+02	6.59E-12	5.85E-13
Dithiane	1.34E-18	4.09E+01	5.47E-17	4.86E-18
Endrin	6.65E-18	4.09E+01	2.72E-16	2.42E-17
Ethylbenzene	1.92E-13	2.89E-01	5.53E-14	4.91E-15
Hexachlorobenzene	2.27E-15	9.24E+00	2.09E-14	1.86E-15
Hexachlorocyclopentadiene	7.06E-17	4.09E+01	2.89E-15	2.57E-16
Isodrin	2.97E-17	4.09E+01	1.22E-15	1.08E-16
Malathion	2.70E-17	4.09E+01	1.11E-15	9.83E-17
Methanol	1.45E-12	4.09E+01	5.93E-11	5.27E-12
Methyl Chloride	6.38E-13	2.89E-01	1.84E-13	1.64E-14
Methylene Chloride	6.38E-14	2.89E-01	1.84E-14	1.64E-15
4-Nitrophenol	2.82E-16	4.09E+01	1.16E-14	1.03E-15

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Table 8G-1
(continued)

	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
PAHs				
Acenaphthalene	3.35E-13	4.09E+01	1.37E-11	1.22E-12
Acenaphthene	3.31E-13	4.09E+01	1.36E-11	1.20E-12
Benzo(a)pyrene	6.60E-14	4.09E+01	2.70E-12	2.40E-13
Chrysene	6.61E-14	4.09E+01	2.70E-12	2.40E-13
Dibenzo(a,h)anthracene	7.33E-14	4.09E+01	3.00E-12	2.67E-13
Fluoranthene	1.98E-13	4.09E+01	8.10E-12	7.20E-13
Fluorene	6.63E-14	4.09E+01	2.71E-12	2.41E-13
Phenanthrene	1.32E-13	4.09E+01	5.39E-12	4.79E-13
Pyrene	6.58E-14	4.09E+01	2.69E-12	2.39E-13
Parathion	3.73E-18	4.09E+01	1.53E-16	1.36E-17
Pentachlorobenzene	1.02E-15	9.24E+00	9.45E-15	8.40E-16
Phenol	4.06E-12	2.89E-01	1.17E-12	1.04E-13
Pyridine	3.06E-17	4.09E+01	1.25E-15	1.11E-16
Quinoline	1.64E-16	4.09E+01	6.72E-15	5.97E-16
Styrene	6.40E-13	2.89E-01	1.85E-13	1.64E-14
Supona	1.12E-17	4.09E+01	4.60E-16	4.09E-17
Tetrachlorobenzene	4.45E-16	9.24E+00	4.11E-15	3.65E-16
Tetrachloroethene	2.54E-15	2.89E-01	7.33E-16	6.52E-17
Toluene	3.19E-13	4.81E-02	1.54E-14	1.36E-15
Trichlorobenzene	2.24E-16	9.24E+00	2.06E-15	1.83E-16
Trichloroethene	3.91E-16	2.89E-01	1.13E-16	1.00E-17
Urea	7.99E-11	4.09E+01	3.27E-09	2.91E-10
Vapona	3.11E-17	4.09E+01	1.27E-15	1.13E-16
Vinyl Chloride	6.38E-13	2.89E-01	1.84E-13	1.64E-14
Xylene	1.28E-13	9.62E-03	1.23E-15	1.09E-16

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Table 8G-2

Pollutant Concentrations in Breast Milk, Resident-B Scenario

	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
ORGANICS				
Acetone	7.89E-18	2.89E-01	2.28E-18	2.03E-19
Acetonitrile	4.54E-15	4.09E+01	1.86E-13	1.65E-14
Acrylonitrile	4.79E-17	5.13E-02	2.46E-18	2.19E-19
Aldrin	1.76E-17	4.09E+01	7.20E-16	6.40E-17
Atrazine	1.24E-18	4.09E+01	5.09E-17	4.53E-18
Benzaldehyde	1.53E-13	4.09E+01	6.26E-12	5.57E-13
Benzene	1.03E-13	1.92E-02	1.97E-15	1.75E-16
Benzofuran	2.52E-13	4.09E+01	1.03E-11	9.17E-13
Benzoic Acid	6.61E-14	4.09E+01	2.71E-12	2.41E-13
Benzonitrile	6.86E-17	4.09E+01	2.81E-15	2.50E-16
Biphenyl	5.00E-14	4.09E+01	2.05E-12	1.82E-13
Bromomethane	1.00E-14	2.89E-01	2.88E-15	2.56E-16
Carbazole	1.12E-17	4.09E+01	4.60E-16	4.09E-17
Carbon Tetrachloride	3.18E-17	2.89E-01	9.18E-18	8.16E-19
Chlorobenzene	2.47E-14	2.89E-01	7.12E-15	6.33E-16
4-Chlorobiphenyl	6.32E-14	4.09E+01	2.59E-12	2.30E-13
4,4-Chlorobiphenyl	8.21E-16	4.09E+01	3.36E-14	2.99E-15
Chloroform	5.04E-18	2.89E-01	1.45E-18	1.29E-19
4-Chlorophenylmethylsulfone	2.50E-17	4.09E+01	1.02E-15	9.11E-17
4-Chlorophenylmethylsulfoxide	9.11E-17	4.09E+01	3.73E-15	3.32E-16
p,p-DDE	9.44E-15	3.69E+01	3.49E-13	3.10E-14
p,p-DDT	2.14E-18	1.85E+01	3.96E-17	3.52E-18
Dibenzofuran	1.11E-14	4.09E+01	4.56E-13	4.05E-14
Dichlorobenzenes (total)	1.80E-17	2.89E-01	5.19E-18	4.61E-19
1,4-Dichlorobenzene	1.14E-18	2.89E-01	3.28E-19	2.91E-20
1,1-Dichloroethene	2.79E-17	2.89E-01	8.07E-18	7.17E-19
1,2-Dichloroethene	1.94E-17	2.89E-01	5.61E-18	4.99E-19
1,2-Dichloropropane	2.26E-18	2.89E-01	6.54E-19	5.81E-20
Dieldrin	1.42E-17	4.09E+01	5.82E-16	5.17E-17
Diisopropyl Methylphosphonate	2.32E-16	4.09E+01	9.49E-15	8.43E-16
1,3-Dimethylbenzene	2.36E-14	4.09E+01	9.65E-13	8.58E-14
Dimethyldisulfide	5.08E-16	4.09E+01	2.08E-14	1.85E-15
Dimethyl Methylphosphonate	8.09E-15	4.09E+01	3.31E-13	2.94E-14
Dimethylphosphate	1.23E-15	4.09E+01	5.04E-14	4.48E-15
Dioxins/Furans (EPA TEFs)	3.27E-15	3.26E+02	1.07E-12	9.50E-14
Dithiane	3.84E-19	4.09E+01	1.57E-17	1.40E-18
Endrin	1.05E-18	4.09E+01	4.30E-17	3.82E-18
Ethylbenzene	3.00E-14	2.89E-01	8.65E-15	7.69E-16
Hexachlorobenzene	3.93E-16	9.24E+00	3.63E-15	3.23E-16
Hexachlorocyclopentadiene	2.22E-17	4.09E+01	9.08E-16	8.07E-17
Isodrin	2.02E-17	4.09E+01	8.26E-16	7.34E-17
Malathion	4.57E-18	4.09E+01	1.87E-16	1.66E-17
Methanol	1.12E-12	4.09E+01	4.57E-11	4.06E-12
Methyl Chloride	1.00E-13	2.89E-01	2.88E-14	2.56E-15
Methylene Chloride	1.00E-14	2.89E-01	2.88E-15	2.56E-16
4-Nitrophenol	5.14E-17	4.09E+01	2.11E-15	1.87E-16

Table 8G-2
(continued)

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	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
PAHs				
Acenaphthalene	6.20E-14	4.09E+01	2.54E-12	2.26E-13
Acenaphthene	5.63E-14	4.09E+01	2.30E-12	2.05E-13
Benzo(a)pyrene	1.09E-14	4.09E+01	4.45E-13	3.96E-14
Chrysene	1.10E-14	4.09E+01	4.50E-13	4.00E-14
Dibenzo(a,h)anthracene	1.82E-14	4.09E+01	7.44E-13	6.62E-14
Fluoranthene	3.26E-14	4.09E+01	1.33E-12	1.18E-13
Fluorene	1.15E-14	4.09E+01	4.72E-13	4.20E-14
Phenanthrene	2.14E-14	4.09E+01	8.76E-13	7.79E-14
Pyrene	1.08E-14	4.09E+01	4.40E-13	3.91E-14
Parathion	6.37E-19	4.09E+01	2.61E-17	2.32E-18
Pentachlorobenzene	1.92E-16	9.24E+00	1.77E-15	1.58E-16
Phenol	1.31E-12	2.89E-01	3.78E-13	3.36E-14
Pyridine	4.79E-18	4.09E+01	1.96E-16	1.74E-17
Quinoline	3.54E-17	4.09E+01	1.45E-15	1.29E-16
Styrene	1.00E-13	2.89E-01	2.89E-14	2.57E-15
Supona	1.95E-18	4.09E+01	7.98E-17	7.10E-18
Tetrachlorobenzene	1.00E-16	9.24E+00	9.27E-16	8.24E-17
Tetrachloroethene	3.98E-16	2.89E-01	1.15E-16	1.02E-17
Toluene	5.00E-14	4.81E-02	2.40E-15	2.14E-16
Trichlorobenzene	3.69E-17	9.24E+00	3.41E-16	3.03E-17
Trichloroethene	6.12E-17	2.89E-01	1.77E-17	1.57E-18
Urea	1.09E-10	4.09E+01	4.47E-09	3.98E-10
Vapona	6.83E-18	4.09E+01	2.79E-16	2.48E-17
Vinyl Chloride	1.00E-13	2.89E-01	2.88E-14	2.56E-15
Xylene	2.00E-14	9.62E-03	1.92E-16	1.71E-17

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Table 8G-3

Pollutant Concentrations in Breast Milk, Farmer Scenario

	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
ORGANICS				
Acetone	1.77E-17	2.89E-01	5.11E-18	4.54E-19
Acetonitrile	1.40E-14	4.09E+01	5.72E-13	5.08E-14
Acrylonitrile	1.07E-16	5.13E-02	5.51E-18	4.90E-19
Aldrin	1.18E-16	4.09E+01	4.85E-15	4.31E-16
Atrazine	2.97E-18	4.09E+01	1.21E-16	1.08E-17
Benzaldehyde	3.27E-13	4.09E+01	1.34E-11	1.19E-12
Benzene	2.30E-13	1.92E-02	4.42E-15	3.93E-16
Benzofuran	6.45E-13	4.09E+01	2.64E-11	2.35E-12
Benzoic Acid	1.48E-13	4.09E+01	6.04E-12	5.37E-13
Benzonitrile	1.48E-16	4.09E+01	6.07E-15	5.39E-16
Biphenyl	1.12E-13	4.09E+01	4.59E-12	4.08E-13
Bromomethane	2.24E-14	2.89E-01	6.46E-15	5.75E-16
Carbazole	2.81E-17	4.09E+01	1.15E-15	1.02E-16
Carbon Tetrachloride	7.13E-17	2.89E-01	2.06E-17	1.83E-18
Chlorobenzene	5.53E-14	2.89E-01	1.60E-14	1.42E-15
4-Chlorobiphenyl	1.54E-13	4.09E+01	6.32E-12	5.62E-13
4,4-Chlorobiphenyl	2.08E-15	4.09E+01	8.50E-14	7.55E-15
Chloroform	1.13E-17	2.89E-01	3.26E-18	2.90E-19
4-Chlorophenylmethylsulfone	5.30E-17	4.09E+01	2.17E-15	1.93E-16
4-Chlorophenylmethylsulfoxide	1.99E-16	4.09E+01	8.16E-15	7.25E-16
p,p-DDE	2.24E-14	3.69E+01	8.27E-13	7.35E-14
p,p-DDT	6.80E-18	1.85E+01	1.26E-16	1.12E-17
Dibenzofuran	2.74E-14	4.09E+01	1.12E-12	9.96E-14
Dichlorobenzenes (total)	4.03E-17	2.89E-01	1.16E-17	1.03E-18
1,4-Dichlorobenzene	2.55E-18	2.89E-01	7.35E-19	6.53E-20
1,1-Dichloroethene	6.26E-17	2.89E-01	1.81E-17	1.61E-18
1,2-Dichloroethene	4.36E-17	2.89E-01	1.26E-17	1.12E-18
1,2-Dichloropropane	5.07E-18	2.89E-01	1.46E-18	1.30E-19
Dieldrin	7.04E-17	4.09E+01	2.88E-15	2.56E-16
Diisopropyl Methylphosphonate	5.14E-16	4.09E+01	2.10E-14	1.87E-15
1,3-Dimethylbenzene	5.92E-14	4.09E+01	2.42E-12	2.16E-13
Dimethyldisulfide	1.14E-15	4.09E+01	4.66E-14	4.14E-15
Dimethyl Methylphosphonate	1.54E-14	4.09E+01	6.29E-13	5.59E-14
Dimethylphosphate	2.79E-15	4.09E+01	1.14E-13	1.02E-14
Dioxins/Furans (EPA TEFs)	9.01E-15	3.26E+02	2.94E-12	2.61E-13
Dithiane	7.47E-19	4.09E+01	3.06E-17	2.72E-18
Endrin	2.39E-18	4.09E+01	9.80E-17	8.71E-18
Ethylbenzene	6.72E-14	2.89E-01	1.94E-14	1.72E-15
Hexachlorobenzene	1.03E-15	9.24E+00	9.51E-15	8.45E-16
Hexachlorocyclopentadiene	8.70E-17	4.09E+01	3.56E-15	3.17E-16
Isodrin	9.79E-17	4.09E+01	4.01E-15	3.56E-16
Malathion	1.05E-17	4.09E+01	4.31E-16	3.83E-17
Methanol	1.75E-12	4.09E+01	7.17E-11	6.37E-12
Methyl Chloride	2.24E-13	2.89E-01	6.46E-14	5.75E-15
Methylene Chloride	2.24E-14	2.89E-01	6.46E-15	5.75E-16
4-Nitrophenol	1.30E-16	4.09E+01	5.34E-15	4.75E-16

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Table 8G-3
(continued)

	Maximum Total Daily Intake (mg/kg/day)	Breast milk Transfer Factor (day)	Maximum Breast milk Conc. mg/kg	Maximum Estimated Daily Intake mg/kg/day
PAHs				
Acenaphthalene	1.69E-13	4.09E+01	6.91E-12	6.14E-13
Acenaphthene	1.39E-13	4.09E+01	5.69E-12	5.06E-13
Benzo(a)pyrene	3.54E-14	4.09E+01	1.45E-12	1.29E-13
Chrysene	2.79E-14	4.09E+01	1.14E-12	1.02E-13
Dibenzo(a,h)anthracene	4.51E-14	4.09E+01	1.85E-12	1.64E-13
Fluoranthene	8.07E-14	4.09E+01	3.30E-12	2.94E-13
Fluorene	2.95E-14	4.09E+01	1.21E-12	1.07E-13
Phenanthrene	5.10E-14	4.09E+01	2.09E-12	1.86E-13
Pyrene	2.61E-14	4.09E+01	1.07E-12	9.51E-14
Parathion	1.58E-18	4.09E+01	6.45E-17	5.74E-18
Pentachlorobenzene	5.42E-16	9.24E+00	5.00E-15	4.45E-16
Phenol	4.32E-12	2.89E-01	1.25E-12	1.11E-13
Pyridine	1.07E-17	4.09E+01	4.40E-16	3.91E-17
Quinoline	9.48E-17	4.09E+01	3.88E-15	3.45E-16
Styrene	2.24E-13	2.89E-01	6.48E-14	5.76E-15
Supona	4.74E-18	4.09E+01	1.94E-16	1.73E-17
Tetrachlorobenzene	3.25E-16	9.24E+00	3.00E-15	2.67E-16
Tetrachloroethene	8.91E-16	2.89E-01	2.57E-16	2.29E-17
Toluene	1.12E-13	4.81E-02	5.39E-15	4.79E-16
Trichlorobenzene	8.78E-17	9.24E+00	8.11E-16	7.20E-17
Trichloroethene	1.37E-16	2.89E-01	3.96E-17	3.52E-18
Urea	1.53E-10	4.09E+01	6.28E-09	5.58E-10
Vapona	1.45E-17	4.09E+01	5.92E-16	5.27E-17
Vinyl Chloride	2.24E-13	2.89E-01	6.46E-14	5.75E-15
Xylene	4.48E-14	9.62E-03	4.31E-16	3.83E-17

APPENDIX 8G

CITED REFERENCES

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APPENDIX 8H

CARCINOGENIC RISK FOR INDIVIDUALS UNDER ALL SCENARIOS

DRAFT

Table 8H-1

Carcinogenic Risk Through all Routes of Exposure for the Adult, Resident-A Scenario

	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL ADULT CARC. RISK
ORGANICS							
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA
Aldrin	1.01E-16	1.29E-18	1.85E-19	2.68E-19	3.24E-21	1.12E-20	1.03E-16
Benzene	NA	NA	NA	NA	NA	NA	NA
Carbazole	1.78E-20	6.18E-24	2.37E-24	5.94E-22	2.33E-22	2.48E-23	1.86E-20
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA
p,p-DDE	1.36E-17	9.17E-19	1.50E-19	1.66E-18	1.98E-16	6.92E-20	2.14E-16
p,p-DDT	1.03E-20	7.64E-22	1.04E-22	3.33E-22	4.13E-20	1.39E-23	5.29E-20
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA
Dieldrin	1.31E-16	2.27E-20	4.97E-21	5.17E-20	1.30E-19	2.16E-21	1.31E-16
Dioxins/Furans (EPA TEFs)	2.43E-12	2.83E-13	1.51E-13	3.49E-13	3.07E-12	1.46E-14	6.30E-12
Hexachlorobenzene	7.41E-18	1.03E-19	1.64E-20	2.11E-19	6.45E-18	8.80E-21	1.42E-17
Methyl Chloride	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA
PAHs							
Benzo(a)pyrene	5.07E-16	1.61E-16	1.85E-17	6.27E-18	1.33E-16	2.61E-19	8.26E-16
Chrysene	5.82E-16	3.84E-17	4.56E-18	7.85E-18	3.36E-15	3.27E-19	3.99E-15
Dibenzo(a,h)anthracene	5.18E-16	1.95E-16	2.23E-17	8.52E-18	7.52E-14	3.55E-19	7.60E-14
Parathion	NE	NE	NE	NE	NE	NE	NE
Quinoline	8.25E-17	2.66E-21	1.04E-21	8.88E-19	1.34E-19	3.70E-20	8.35E-17
Styrene	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA	NA	NA	NA
Vapona	4.01E-19	6.57E-24	2.57E-24	4.05E-21	2.34E-22	1.69E-22	4.06E-19
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA
INORGANICS							
Arsenic	2.23E-11	1.15E-11	1.50E-13	1.43E-11	2.39E-11	5.95E-13	7.27E-11
Beryllium	5.18E-13	8.15E-18	3.93E-16	3.59E-13	3.02E-14	1.50E-14	9.22E-13
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA	NA	NA
Lead	NE	NE	NE	NE	NE	NE	NE
Nickel	NA	NA	NA	NA	NA	NA	NA
Total	2.53E-11	1.18E-11	3.01E-13	1.50E-11	2.70E-11	6.25E-13	8.00E-11

Table 8H-2

Carcinogenic Risk Through all Routes of Exposure for the Adult, Resident-B Scenario

	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL ADULT CARC. RISK
ORGANICS							
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA
Aldrin	1.45E-16	1.29E-18	1.85E-19	3.87E-19	3.24E-21	1.61E-20	1.47E-16
Benzene	NA	NA	NA	NA	NA	NA	NA
Carbazole	2.46E-20	6.18E-24	2.37E-24	8.59E-22	2.33E-22	3.58E-23	2.57E-20
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA
p,p-DDE	3.30E-18	9.17E-19	1.50E-19	2.40E-18	1.98E-16	1.00E-19	2.05E-16
p,p-DDT	1.17E-20	7.64E-22	1.04E-22	4.81E-22	4.13E-20	2.00E-23	5.44E-20
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA
Dieldrin	1.89E-16	2.27E-20	4.97E-21	7.48E-20	1.30E-19	3.12E-21	1.89E-16
Dioxins/Furans (EPA TEFs)	9.02E-13	2.83E-13	1.51E-13	5.05E-13	3.07E-12	2.10E-14	4.93E-12
Hexachlorobenzene	7.62E-18	1.03E-19	1.64E-20	3.05E-19	6.45E-18	1.27E-20	1.45E-17
Methyl Chloride	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA
PAHs							
Benzo(a)pyrene	8.12E-17	1.61E-16	1.85E-17	9.06E-18	1.33E-16	3.78E-19	4.03E-16
Chrysene	1.90E-16	3.84E-17	4.56E-18	1.13E-17	3.36E-15	4.73E-19	3.60E-15
Dibenzo(a,h)anthracene	9.82E-17	1.95E-16	2.23E-17	1.23E-17	7.52E-14	5.13E-19	7.56E-14
Parathion	NE	NE	NE	NE	NE	NE	NE
Quinoline	1.18E-16	2.66E-21	1.04E-21	1.28E-18	1.34E-19	5.35E-20	1.19E-16
Styrene	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA	NA	NA	NA
Vapona	5.73E-19	6.57E-24	2.57E-24	5.86E-21	2.34E-22	2.44E-22	5.79E-19
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA
INORGANICS							
Arsenic	6.11E-12	1.15E-11	1.50E-13	2.06E-11	2.39E-11	8.60E-13	6.31E-11
Beryllium	9.13E-14	8.15E-18	3.93E-16	5.19E-13	3.02E-14	2.16E-14	6.63E-13
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA	NA	NA
Lead	NE	NE	NE	NE	NE	NE	NE
Nickel	NA	NA	NA	NA	NA	NA	NA
Total	7.11E-12	1.18E-11	3.01E-13	2.17E-11	2.70E-11	9.03E-13	6.88E-11

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Table 8H-3

Carcinogenic Risk Through all Routes of Exposure for the Adult, Farmer Scenario

	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL ADULT CARC. RISK
ORGANICS							
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA
Aldrin	7.45E-16	2.59E-17	3.71E-18	2.29E-19	3.24E-21	1.09E-19	7.75E-16
Benzene	NA	NA	NA	NA	NA	NA	NA
Carbazole	1.04E-19	1.24E-22	4.73E-23	5.10E-22	2.33E-22	2.43E-22	1.05E-19
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA
p,p-DDE	1.21E-17	1.83E-17	3.01E-18	1.42E-18	1.98E-16	6.79E-19	2.33E-16
p,p-DDT	5.93E-20	1.53E-20	2.08E-21	2.85E-22	4.13E-20	1.36E-22	1.18E-19
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA
Dieldrin	9.69E-16	4.54E-19	9.95E-20	4.43E-20	1.30E-19	2.11E-20	9.70E-16
Dioxins/Furans (EPA TEFs)	3.96E-12	5.65E-12	3.01E-12	2.99E-13	3.07E-12	1.43E-13	1.61E-11
Hexachlorobenzene	3.83E-17	2.06E-18	3.29E-19	1.81E-19	6.45E-18	8.63E-20	4.74E-17
Methyl Chloride	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA
PAHs							
Benzo(a)pyrene	3.21E-16	3.23E-15	3.69E-16	5.37E-18	1.33E-16	2.56E-18	4.06E-15
Chrysene	8.74E-16	7.69E-16	9.11E-17	6.73E-18	3.36E-15	3.21E-18	5.10E-15
Dibenzo(a,h)anthracene	4.08E-16	3.89E-15	4.47E-16	7.30E-18	7.52E-14	3.48E-18	8.00E-14
Parathion	NE	NE	NE	NE	NE	NE	NE
Quinoline	4.24E-16	5.31E-20	2.07E-20	7.61E-19	1.34E-19	3.63E-19	4.25E-16
Styrene	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA	NA	NA	NA
Vapona	1.03E-18	1.31E-22	5.14E-23	3.47E-21	2.34E-22	1.66E-21	1.04E-18
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA
INORGANICS							
Arsenic	1.59E-11	2.30E-10	3.00E-12	1.22E-11	2.39E-11	5.84E-12	2.91E-10
Beryllium	3.02E-13	1.63E-16	7.86E-15	3.08E-13	3.02E-14	1.47E-13	7.95E-13
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium (VI)	NA	NA	NA	NA	NA	NA	NA
Lead	NE	NE	NE	NE	NE	NE	NE
Nickel	NA	NA	NA	NA	NA	NA	NA
Total	2.02E-11	2.35E-10	6.03E-12	1.28E-11	2.70E-11	6.12E-12	3.08E-10

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Table 8H-4

Carcinogenic Risk Through all Routes of Exposure for the Adult, Worker Scenario

	INHALATION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL WORKER CARC. RISK
ORGANICS				
Acrylonitrile	2.11E-19	NA	NA	2.11E-19
Aldrin	1.59E-18	5.07E-20	7.85E-20	1.71E-18
Benzene	5.46E-17	NA	NA	5.46E-17
Carbazole	3.52E-21	1.13E-22	1.74E-22	3.81E-21
Carbon Tetrachloride	7.60E-20	NA	NA	7.60E-20
Chloroform	7.49E-21	NA	NA	7.49E-21
p,p-DDE	5.27E-17	3.15E-19	4.87E-19	5.35E-17
p,p-DDT	1.06E-20	6.30E-23	9.75E-23	1.07E-20
1,4-Dichlorobenzene	5.01E-22	NA	NA	5.01E-22
1,1-Dichloroethene	6.16E-19	NA	NA	6.16E-19
1,2-Dichloropropane	2.83E-21	NA	NA	2.83E-21
Dieldrin	3.06E-19	9.80E-21	1.52E-20	3.31E-19
Dioxins/Furans (EPA TEFs)	6.35E-12	6.62E-14	1.02E-13	6.52E-12
Hexachlorobenzene	1.00E-17	4.00E-20	6.19E-20	1.01E-17
Methyl Chloride	1.16E-17	NA	NA	1.16E-17
Methylene Chloride	2.57E-18	NA	NA	2.57E-18
PAHs				
Benzo(a)pyrene	1.12E-15	1.19E-18	1.84E-18	1.12E-15
Chrysene	1.12E-15	1.49E-18	2.30E-18	1.12E-15
Dibenzo(a,h)anthracene	1.12E-15	1.61E-18	2.50E-18	1.12E-15
Parathion	NE	NE	NE	NE
Quinoline	5.26E-18	1.68E-19	2.60E-19	5.69E-18
Styrene	3.68E-18	NA	NA	3.68E-18
Tetrachloroethene	2.41E-20	NA	NA	2.41E-20
Trichloroethene	1.24E-20	NA	NA	1.24E-20
Vapona	2.40E-20	7.68E-22	1.19E-21	2.60E-20
Vinyl Chloride	2.70E-16	NA	NA	2.70E-16
INORGANICS				
Arsenic	7.25E-10	2.71E-12	4.18E-12	7.32E-10
Beryllium	4.15E-12	6.80E-14	1.05E-13	4.33E-12
Cadmium	8.59E-12	NA	NA	8.59E-12
Chromium (VI)	4.64E-12	NA	NA	4.64E-12
Lead	NE	NE	NE	NE
Nickel	7.72E-12	NA	NA	7.72E-12
Total	7.56E-10	2.84E-12	4.39E-12	7.64E-10

Table 8II-5

Carcinogenic Risk Through all Routes of Exposure for the Child, Resident-A Scenario

	INHALATION CARC. RISK	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL CHILD CARC. RISK
ORGANICS								
Acrylonitrile	2.37E-18	NA	NA	NA	NA	NA	NA	2.37E-18
Aldrin	1.78E-17	1.18E-17	5.84E-19	3.61E-20	1.89E-19	5.71E-22	1.69E-20	3.04E-17
Benzene	6.13E-16	NA	NA	NA	NA	NA	NA	6.13E-16
Carbazole	3.95E-20	2.28E-21	2.79E-24	4.61E-25	4.20E-22	4.11E-23	3.75E-23	4.23E-20
Carbon Tetrachloride	8.52E-19	NA	NA	NA	NA	NA	NA	8.52E-19
Chloroform	8.41E-20	NA	NA	NA	NA	NA	NA	8.41E-20
p,p-DDE	5.92E-16	1.95E-18	4.14E-19	2.93E-20	1.17E-18	3.49E-17	1.05E-19	6.30E-16
p,p-DDT	1.18E-19	1.28E-21	3.45E-22	2.02E-23	2.35E-22	7.29E-21	2.10E-23	1.28E-19
1,4-Dichlorobenzene	5.62E-21	NA	NA	NA	NA	NA	NA	5.62E-21
1,1-Dichloroethene	6.91E-18	NA	NA	NA	NA	NA	NA	6.91E-18
1,2-Dichloropropane	3.17E-20	NA	NA	NA	NA	NA	NA	3.17E-20
Dieldrin	3.44E-18	1.53E-17	1.02E-20	9.69E-22	3.65E-20	2.30E-20	3.26E-21	1.88E-17
Dioxins/Furans (EPA TEFs)	7.12E-11	3.42E-13	1.45E-13	3.19E-14	2.46E-13	5.42E-13	2.20E-14	7.26E-11
Hexachlorobenzene	1.12E-16	9.37E-19	4.64E-20	3.20E-21	1.49E-19	1.14E-18	1.33E-20	1.15E-16
Methyl Chloride	1.30E-16	NA	NA	NA	NA	NA	NA	1.30E-16
Methylene Chloride	2.88E-17	NA	NA	NA	NA	NA	NA	2.88E-17
PAHs								
Benzo(a)pyrene	1.25E-14	7.32E-17	7.29E-17	3.60E-18	4.42E-18	2.34E-17	3.96E-19	1.27E-14
Chrysene	1.25E-14	8.21E-17	1.73E-17	8.88E-19	5.54E-18	5.92E-16	4.96E-19	1.32E-14
Dibenzo(a,h)anthracene	1.25E-14	7.46E-17	8.78E-17	4.35E-18	6.01E-18	1.33E-14	5.38E-19	2.60E-14
Parathion	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	5.90E-17	1.11E-17	1.20E-21	2.02E-22	6.27E-19	2.37E-20	5.60E-20	7.08E-17
Styrene	4.13E-17	NA	NA	NA	NA	NA	NA	4.13E-17
Tetrachloroethene	2.70E-19	NA	NA	NA	NA	NA	NA	2.70E-19
Trichloroethene	1.39E-19	NA	NA	NA	NA	NA	NA	1.39E-19
Vapona	2.69E-19	6.22E-20	2.96E-24	5.01E-25	2.86E-21	4.13E-23	2.56E-22	3.35E-19
Vinyl Chloride	3.03E-15	NA	NA	NA	NA	NA	NA	3.03E-15
INORGANICS								
Arsenic	8.13E-09	3.15E-12	5.18E-12	2.93E-14	1.01E-11	4.21E-12	9.01E-13	8.16E-09
Beryllium	4.66E-11	7.45E-14	3.68E-18	7.65E-17	2.53E-13	5.32E-15	2.27E-14	4.70E-11
Cadmium	9.64E-11	NA	NA	NA	NA	NA	NA	9.64E-11
Chromium (VI)	5.20E-11	NA	NA	NA	NA	NA	NA	5.20E-11
Lead	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	8.66E-11	NA	NA	NA	NA	NA	NA	8.66E-11
Total	8.49E-09	3.57E-12	5.33E-12	6.13E-14	1.06E-11	4.77E-12	9.46E-13	8.51E-09

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Table 8H-6

Carcinogenic Risk Through all Routes of Exposure for the Child, Resident-B Scenario

	INHALATION CARC. RISK	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL CHILD CARC. RISK
ORGANICS								
Acrylonitrile	3.71E-19	NA	NA	NA	NA	NA	NA	3.71E-19
Aldrin	2.79E-18	1.70E-17	5.84E-19	3.61E-20	2.73E-19	5.71E-22	2.44E-20	2.07E-17
Benzene	9.60E-17	NA	NA	NA	NA	NA	NA	9.60E-17
Carbazole	6.19E-21	3.14E-21	2.79E-24	4.61E-25	6.06E-22	4.11E-23	5.42E-23	1.00E-20
Carbon Tetrachloride	1.33E-19	NA	NA	NA	NA	NA	NA	1.33E-19
Chloroform	1.32E-20	NA	NA	NA	NA	NA	NA	1.32E-20
p,p-DDE	9.26E-17	4.64E-19	4.14E-19	2.93E-20	1.69E-18	3.49E-17	1.52E-19	1.30E-16
p,p-DDT	1.85E-20	1.38E-21	3.45E-22	2.02E-23	3.39E-22	7.29E-21	3.03E-23	2.79E-20
1,4-Dichlorobenzene	8.79E-22	NA	NA	NA	NA	NA	NA	8.79E-22
1,1-Dichloroethene	1.08E-18	NA	NA	NA	NA	NA	NA	1.08E-18
1,2-Dichloropropane	4.97E-21	NA	NA	NA	NA	NA	NA	4.97E-21
Dieldrin	5.38E-19	2.21E-17	1.02E-20	9.69E-22	5.28E-20	2.30E-20	4.72E-21	2.27E-17
Dioxins/Furans (EPA TEFs)	1.12E-11	1.17E-13	1.45E-13	3.19E-14	3.56E-13	5.42E-13	3.18E-14	1.24E-11
Hexachlorobenzene	1.76E-17	9.06E-19	4.64E-20	3.20E-21	2.15E-19	1.14E-18	1.93E-20	1.99E-17
Methyl Chloride	2.03E-17	NA	NA	NA	NA	NA	NA	2.03E-17
Methylene Chloride	4.51E-18	NA	NA	NA	NA	NA	NA	4.51E-18
PAHs								
Benzo(a)pyrene	1.96E-15	1.15E-17	7.29E-17	3.60E-18	6.39E-18	2.34E-17	5.72E-19	2.08E-15
Chrysene	1.96E-15	2.43E-17	1.73E-17	8.88E-19	8.01E-18	5.92E-16	7.16E-19	2.61E-15
Dibenzo(a,h)anthracene	1.96E-15	1.35E-17	8.78E-17	4.35E-18	8.69E-18	1.33E-14	7.77E-19	1.54E-14
Parathion	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	9.24E-18	1.58E-17	1.20E-21	2.02E-22	9.06E-19	2.37E-20	8.10E-20	2.61E-17
Styrene	6.46E-18	NA	NA	NA	NA	NA	NA	6.46E-18
Tetrachloroethene	4.23E-20	NA	NA	NA	NA	NA	NA	4.23E-20
Trichloroethene	2.17E-20	NA	NA	NA	NA	NA	NA	2.17E-20
Vapona	4.22E-20	8.89E-20	2.96E-24	5.01E-25	4.14E-21	4.13E-23	3.70E-22	1.36E-19
Vinyl Chloride	4.74E-16	NA	NA	NA	NA	NA	NA	4.74E-16
INORGANICS								
Arsenic	1.27E-09	7.73E-13	5.18E-12	2.93E-14	1.46E-11	4.21E-12	1.30E-12	1.30E-09
Beryllium	7.30E-12	1.25E-14	3.68E-18	7.65E-17	3.66E-13	5.32E-15	3.27E-14	7.71E-12
Cadmium	1.51E-11	NA	NA	NA	NA	NA	NA	1.51E-11
Chromium (VI)	8.15E-12	NA	NA	NA	NA	NA	NA	8.15E-12
Lead	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	1.36E-11	NA	NA	NA	NA	NA	NA	1.36E-11
Total	1.33E-09	9.03E-13	5.33E-12	6.13E-14	1.53E-11	4.77E-12	1.37E-12	1.36E-09

Table 8II-7

Carcinogenic Risk Through all Routes of Exposure for the Child, Farmer Scenario

	INHALATION CARC. RISK	VEGETABLE INGESTION CARC. RISK	MILK INGESTION CARC. RISK	BEEF INGESTION CARC. RISK	SOIL/DUST INGESTION CARC. RISK	FISH INGESTION CARC. RISK	DERMAL EXPOSURE CARC. RISK	TOTAL CHILD CARC. RISK
ORGANICS								
Acrylonitrile	8.32E-19	NA	NA	NA	NA	NA	NA	8.32E-19
Aldrin	6.24E-18	1.25E-16	1.17E-17	7.22E-19	1.62E-19	5.71E-22	1.45E-20	1.44E-16
Benzene	2.15E-16	NA	NA	NA	NA	NA	NA	2.15E-16
Carbazole	1.39E-20	1.74E-20	5.57E-23	9.22E-24	3.60E-22	4.11E-23	3.22E-23	3.18E-20
Carbon Tetrachloride	2.99E-19	NA	NA	NA	NA	NA	NA	2.99E-19
Chloroform	2.95E-20	NA	NA	NA	NA	NA	NA	2.95E-20
p,p-DDE	2.08E-16	1.88E-18	8.27E-18	5.86E-19	1.00E-18	3.49E-17	8.98E-20	2.54E-16
p,p-DDT	4.16E-20	9.93E-21	6.90E-21	4.05E-22	2.01E-22	7.29E-21	1.80E-23	6.63E-20
1,4-Dichlorobenzene	1.97E-21	NA	NA	NA	NA	NA	NA	1.97E-21
1,1-Dichloroethene	2.42E-18	NA	NA	NA	NA	NA	NA	2.42E-18
1,2-Dichloropropane	1.11E-20	NA	NA	NA	NA	NA	NA	1.11E-20
Dieldrin	1.21E-18	1.63E-16	2.05E-19	1.94E-20	3.13E-20	2.30E-20	2.80E-21	1.64E-16
Dioxins/Furans (EPA TEFs)	2.50E-11	6.40E-13	2.90E-12	6.38E-13	2.11E-13	5.42E-13	1.89E-14	2.99E-11
Hexachlorobenzene	3.94E-17	6.40E-18	9.28E-19	6.40E-20	1.28E-19	1.14E-18	1.14E-20	4.81E-17
Methyl Chloride	4.55E-17	NA	NA	NA	NA	NA	NA	4.55E-17
Methylene Chloride	1.01E-17	NA	NA	NA	NA	NA	NA	1.01E-17
PAHs								
Benzo(a)pyrene	4.40E-15	4.78E-17	1.46E-15	7.19E-17	3.79E-18	2.34E-17	3.39E-19	6.00E-15
Chrysene	4.40E-15	1.41E-16	3.47E-16	1.78E-17	4.75E-18	5.92E-16	4.25E-19	5.50E-15
Dibenzo(a,h)anthracene	4.40E-15	6.23E-17	1.76E-15	8.70E-17	5.15E-18	1.33E-14	4.61E-19	1.96E-14
Parathion	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	2.07E-17	7.11E-17	2.40E-20	4.04E-21	5.37E-19	2.37E-20	4.80E-20	9.24E-17
Styrene	1.45E-17	NA	NA	NA	NA	NA	NA	1.45E-17
Tetrachloroethene	9.49E-20	NA	NA	NA	NA	NA	NA	9.49E-20
Trichloroethene	4.87E-20	NA	NA	NA	NA	NA	NA	4.87E-20
Vapona	9.45E-20	1.73E-19	5.93E-23	1.00E-23	2.45E-21	4.13E-23	2.19E-22	2.70E-19
Vinyl Chloride	1.06E-15	NA	NA	NA	NA	NA	NA	1.06E-15
INORGANICS								
Arsenic	2.85E-09	2.27E-12	1.04E-10	5.85E-13	8.64E-12	4.21E-12	7.72E-13	2.97E-09
Beryllium	1.64E-11	4.35E-14	7.36E-17	1.53E-15	2.17E-13	5.32E-15	1.94E-14	1.66E-11
Cadmium	3.38E-11	NA	NA	NA	NA	NA	NA	3.38E-11
Chromium (VI)	1.83E-11	NA	NA	NA	NA	NA	NA	1.83E-11
Lead	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	3.04E-11	NA	NA	NA	NA	NA	NA	3.04E-11
Total	2.98E-09	2.95E-12	1.07E-10	1.23E-12	9.06E-12	4.77E-12	8.11E-13	3.10E-09

Table 8H-8

Carcinogenic Risk Through all Routes of Exposure for the Infant, Resident-A Scenario

	INHALATION CARC. RISK	BREAST MILK INGESTION CARC. RISK	TOTAL INFANT CARC. RISK
ORGANICS			
Acrylonitrile	1.55E-18	1.08E-20	1.56E-18
Aldrin	1.16E-17	3.78E-17	4.94E-17
Benzene	4.01E-16	4.64E-19	4.02E-16
Carbazole	2.59E-20	6.64E-20	9.22E-20
Carbon Tetrachloride	5.58E-19	9.68E-21	5.67E-19
Chloroform	5.50E-20	7.19E-23	5.51E-20
p,p-DDE	3.87E-16	8.95E-16	1.28E-15
p,p-DDT	7.75E-20	9.12E-20	1.69E-19
1,4-Dichlorobenzene	3.68E-21	6.38E-23	3.74E-21
1,1-Dichloroethene	4.52E-18	3.92E-20	4.56E-18
1,2-Dichloropropane	2.08E-20	3.60E-22	2.11E-20
Dieldrin	2.25E-18	1.33E-17	1.55E-17
Dioxins/Furans (EPA TEFs)	4.66E-11	1.25E-09	1.30E-09
Hexachlorobenzene	7.35E-17	4.25E-17	1.16E-16
Methyl Chloride	8.49E-17	3.04E-18	8.79E-17
Methylene Chloride	1.89E-17	1.75E-19	1.90E-17
PAHs			
Benzo(a)pyrene	8.20E-15	3.95E-14	4.77E-14
Chrysene	8.20E-15	3.95E-14	4.77E-14
Dibenzo(a,h)anthracene	8.20E-15	4.38E-14	5.20E-14
Parathion	NE	NE	NE
Quinoline	3.86E-17	1.02E-16	1.41E-16
Styrene	2.70E-17	7.03E-18	3.40E-17
Tetrachloroethene	1.77E-19	4.75E-20	2.24E-19
Trichloroethene	9.08E-20	1.58E-21	9.23E-20
Vapona	1.76E-19	4.69E-19	6.45E-19
Vinyl Chloride	1.98E-15	5.38E-16	2.52E-15
INORGANICS			
Arsenic	5.32E-09	NE	5.32E-09
Beryllium	3.05E-11	NE	3.05E-11
Cadmium	6.31E-11	NA	6.31E-11
Chromium (VI)	3.40E-11	NA	3.40E-11
Lead	NE	NE	NE
Nickel	5.67E-11	NA	5.67E-11
Total	5.55E-09	1.25E-09	6.81E-09

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Table 8H-9

Carcinogenic Risk Through all Routes of Exposure for the Infant, Resident-B Scenario

	INHALATION CARC. RISK	BREAST MILK INGESTION CARC. RISK	TOTAL INFANT CARC. RISK
ORGANICS			
Acrylonitrile	2.43E-19	1.69E-21	2.45E-19
Aldrin	1.82E-18	1.56E-17	1.74E-17
Benzene	6.28E-17	7.27E-20	6.29E-17
Carbazole	4.05E-21	1.17E-20	1.57E-20
Carbon Tetrachloride	8.73E-20	1.52E-21	8.89E-20
Chloroform	8.62E-21	1.13E-23	8.63E-21
p,p-DDE	6.06E-17	1.51E-16	2.11E-16
p,p-DDT	1.21E-20	1.71E-20	2.92E-20
1,4-Dichlorobenzene	5.76E-22	9.99E-24	5.85E-22
1,1-Dichloroethene	7.08E-19	6.15E-21	7.14E-19
1,2-Dichloropropane	3.25E-21	5.64E-23	3.31E-21
Dieldrin	3.52E-19	1.18E-17	1.22E-17
Dioxins/Furans (EPA TEFs)	7.30E-12	2.04E-10	2.11E-10
Hexachlorobenzene	1.15E-17	7.37E-18	1.89E-17
Methyl Chloride	1.33E-17	4.76E-19	1.38E-17
Methylene Chloride	2.95E-18	2.75E-20	2.98E-18
PAHs			
Benzo(a)pyrene	1.28E-15	6.50E-15	7.79E-15
Chrysene	1.28E-15	6.57E-15	7.86E-15
Dibenzo(a,h)anthracene	1.28E-15	1.09E-14	1.22E-14
Parathion	NE	NE	NE
Quinoline	6.05E-18	2.21E-17	2.81E-17
Styrene	4.23E-18	1.10E-18	5.33E-18
Tetrachloroethene	2.77E-20	7.44E-21	3.51E-20
Trichloroethene	1.42E-20	2.47E-22	1.45E-20
Vapona	2.76E-20	1.03E-19	1.31E-19
Vinyl Chloride	3.10E-16	8.43E-17	3.94E-16
INORGANICS			
Arsenic	8.33E-10	NE	8.33E-10
Beryllium	4.78E-12	NE	4.78E-12
Cadmium	9.88E-12	NA	9.88E-12
Chromium (VI)	5.33E-12	NA	5.33E-12
Lead	NE	NE	NE
Nickel	8.87E-12	NA	8.87E-12
Total	8.69E-10	2.04E-10	1.07E-09

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Table 8H-10

Carcinogenic Risk Through all Routes of Exposure for the Infant, Farmer Scenario

	INHALATION CARC. RISK	BREAST MILK INGESTION CARC. RISK	TOTAL INFANT CARC. RISK
ORGANICS			
Acrylonitrile	5.44E-19	3.78E-21	5.48E-19
Aldrin	4.09E-18	1.05E-16	1.09E-16
Benzene	1.41E-16	1.63E-19	1.41E-16
Carbazole	9.07E-21	2.93E-20	3.83E-20
Carbon Tetrachloride	1.96E-19	3.40E-21	1.99E-19
Chloroform	1.93E-20	2.52E-23	1.93E-20
p,p-DDE	1.36E-16	3.57E-16	4.93E-16
p,p-DDT	2.72E-20	5.42E-20	8.14E-20
1,4-Dichlorobenzene	1.29E-21	2.24E-23	1.31E-21
1,1-Dichloroethene	1.59E-18	1.38E-20	1.60E-18
1,2-Dichloropropane	7.28E-21	1.26E-22	7.41E-21
Dieldrin	7.89E-19	5.86E-17	5.93E-17
Dioxins/Furans (EPA TEFs)	1.64E-11	5.60E-10	5.76E-10
Hexachlorobenzene	2.58E-17	1.93E-17	4.51E-17
Methyl Chloride	2.98E-17	1.07E-18	3.09E-17
Methylene Chloride	6.62E-18	6.16E-20	6.68E-18
PAHs			
Benzo(a)pyrene	2.88E-15	2.12E-14	2.40E-14
Chrysene	2.88E-15	1.67E-14	1.96E-14
Dibenzo(a,h)anthracene	2.88E-15	2.70E-14	2.99E-14
Parathion	NE	NE	NE
Quinoline	1.35E-17	5.92E-17	7.27E-17
Styrene	9.48E-18	2.47E-18	1.19E-17
Tetrachloroethene	6.21E-20	1.67E-20	7.88E-20
Trichloroethene	3.18E-20	5.53E-22	3.24E-20
Vapona	6.19E-20	2.18E-19	2.80E-19
Vinyl Chloride	6.95E-16	1.89E-16	8.84E-16
INORGANICS			
Arsenic	1.87E-09	NE	1.87E-09
Beryllium	1.07E-11	NE	1.07E-11
Cadmium	2.21E-11	NA	2.21E-11
Chromium (VI)	1.19E-11	NA	1.19E-11
Lead	NE	NE	NE
Nickel	1.99E-11	NA	1.99E-11
Total	1.95E-09	5.60E-10	2.51E-09

APPENDIX 9A

DERIVATION OF SELECTED ORAL REFERENCE DOSES (RfDs))

APPENDIX 9A

DERIVATION OF SELECTED ORAL REFERENCE DOSES (RfDs)

In many instances it was necessary to derive an oral RfD from existing toxicity data. Chronic oral toxicity data were used, when available. In the absence of chronic data subchronic or acute oral toxicity data were used.

9A.1 Derivation from No-Observable-Adverse-Effect Levels (NOAELs)

In two cases (benzene and vinyl chloride) oral RfDs were calculated from NOAELS according to EPA guidelines (EPA, 1989). The RfD for benzene was based on a NOAEL of 1 mg/kg/day from a 26-week study in rats. The toxic endpoints manifested in the rats were leucopenia and erythrocytopenia (Wolfe et al., 1956). To extrapolate the oral RfD from the NOAEL, uncertainty factors (UFs) were included. The total UF of 1,000 was calculated by multiplying by 10 for each of the following categories: subchronic to chronic exposure, animal to humans, and human variation. The chronic RfD was then calculated by dividing the NOAEL by the UF of 1,000.

The RfD for vinyl chloride was based on a three-generational study in rats (ATSDR, 1989a). In this case, a reported NOAEL of 0.13 mg/kg/day was established from a lifetime dietary study in rats, in which decreased survival and hepatotoxicity were the most sensitive toxic endpoints (Til et. al., 1983). An uncertainty factor of 100 was applied, 10 for extrapolating from animals to humans, and 10 for human variation.

9A.2 Derivation from Oral Lethality Data

In the absence of chronic and subchronic toxicity data, an oral LD_{50} was used to derive the chronic oral RfD. An LD_{50} is the dose that is lethal to 50 percent of the test animals. This process was used for many chemicals in the report (see Table 9A-1). The chronic oral RfD was calculated by dividing the LD_{50} by an uncertainty factor (UF) of 100,000 in accordance with the approach developed by Layton et. al., (1987).

Table 9A-1

Chronic Oral Reference Doses (RfDs) Derived from LD_{50} Values

Chemical	**LD50**	**Test Species**	**Chronic Oral RfD (mg/kg/day)**
Acrylonitrile	27	mouse	2.70E-04
Benzofuran	500	mouse	5.00E-02
Benzonitrile	800	cat, mouse	8.00E-03
Carbazole	500	rat	5.00E-03
4-Chlorobiphenyl	2,450	rat	2.45E-02
4,4'-Chlorobiphenyl	2,330	rat	2.33E-02
1,3-Dimethylbenzene	5,000	rat	5.00E-02
Dimethylphosphate	8,714	rat	8.71E-02
Methyl Chloride	1,800	rat	2.50E-03
4-Nitrophenol	8,471	rat	8.47E-02

Reference : RTECS, 1990

APPENDIX 9A

CITED REFERENCES

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APPENDIX 9B

DERIVATION OF SELECTED INHALATION REFERENCE DOSES (RfDs)

APPENDIX 9B

DERIVATION OF SELECTED INHALATION REFERENCE DOSES (RfDs)

An inhalation RfD was derived for only one chemical, lithium, based on toxicity data. Lithium hydride was the only form of lithium for which inhalation toxicity data were available. Lithium hydride is intensely irritating and corrosive to the skin and mucous membranes; its TLV-TWA of 0.025 mg/m^3 (ACGIH, 1986) is based on its irritant properties. However, concentrations of lithium hydride ranging from 0.025 to 0.10 mg/m^3, associated with a tickling sensation in the nose and a mild nasal discharge, have been reported to be tolerated by workers continuously exposed (Clayton and Clayton, 1981).

Lithium would not be expected to be present as the hydride in stack emissions and there has been no evidence of industrial health hazards being associated with the inhalation of other forms of lithium (Clayton and Clayton, 1981). Therefore, the use of the TLV-TWA for lithium hydride in deriving an inhalation RfD for lithium would be expected to be overly conservative. However, in the absence of inhalation data for other forms of lithium, the upper limit of the tolerated range for lithium hydride (i.e., 0.10 mg/m^3) was assumed to be an acceptable exposure level for workers for all other forms of lithium. Substituting this value as the "TLV-TWA" in the equation presented in Subsection 9.4.2, Table 9-5, an inhalation RfD for lithium of 1.0E-04 mg/kg/day was derived which would be appropriate for the general public.

APPENDIX 9B

CITED REFERENCES

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